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BASIC TECHNICAL DATA ON TRANSMISSION SYSTEMS AND EQUIPMENT USING COMMUNICATIONS LINES

PART I

U. S. JOINT PUBLICATIONS RESEARCH SERVICE

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16. Abstracts

This report contains the basic technical data on the series produced equipment for the transmission systems of trunk, rural and municipal cable and open wire communications lines, as well as equipment which has been taken out of production, but which still exists on the network in considerable quantity. The following are indicated for each type of equipment: purpose, lines used, electrical characteristics, specific features of the electrical power supply, structural design and equipment complement.

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Converters
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Test equipment
- Oscilloscopes
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- VTVM's
- Signal generators
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BASIC TECHNICAL DATA ON TRANSMISSION SYSTEMS AND EQUIPMENT USING COMMUNICATIONS LINES

PART I

Moscow OSNOVNYYE TEKHNICHESKIYE DANNYYE APPARATURY I SISTEMY PEREDACH PO LINIYAM SVYAZI in Russian 1970 signed to press 28 May 69 pp 1-680

[Book by E.S. Vokler, A.A. Grib, V.G. Novikov, L.G. Shifmanovich and M.I. Shlyakhter, Izdatel'stvo "Svyaz'", 20,700 copies]

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Annotation

[Text] The Equipment of Transmission Systems Using Communications Lines

Handbook

Given in the handbook are the basic technical data on the series produced equipment for the transmission systems of trunk, rural and municipal cable and open wire communications lines, as well as equipment which has been taken out of production, but which still exists on the network in considerable quantity. The following are indicated for each type of equipment: purpose, lines used, electrical characteristics, specific features of the electrical power supply, structural design and equipment complement.

The handbook is intended for engineering and technical personnel engaged in the design, construction and operation of long range communications gear, as well as for students in the advanced courses at electrical engineering institutes and communications technical schools.

Foreword

This handbook is essentially a reworked and supplemented publication of the book which came out in the "Svyaz'" publishing house in 1966 under the title, "Sbornik osnovnykh tekhnicheskikh dannykh apparatury dal'ney svyazi" ["Collection of the Main Technical Data for Long Distance Communications Equipment"].

Given in the handbook are the main technical data for cable and open wire line communications systems, as well as for the auxiliary equipment of the line equipment shops of long distance telephone exchanges, communications centers and repeater stations (test input, wire broadcasting, measurement, etc.).

Included in the handbook are data on equipment which is being both series produced or prepared for series production and removed from production, but still in wide use on the network.

The handbook is broken down into sections according to equipment types as a function of their purpose. The applications area, type of lines, communications system, electrical characteristics, manner of electrical power supply, structural design and equipment complement are indicated for each type of equipment.

The handbook was compiled on the basis of plant engineering documentation, materials of the Central Scientific Research Institute for Communications, Technical Specifications and other documents.

The equipment prices which are given in the book cannot serve as the basis for making estimates, and are only reference data.

The publication is intended for engineering and technical personnel engaged in the design, construction and operation of the equipment for wire communications systems. The handbook can also be used by students of electrical engineering institutes and communications technical schools.

The authors consider it their pleasant duty to express their sincere gratitude to N.E. Popova and O.P. Pustovoytenko for their valuable notes in reviewing and examining the manuscript of the book, as well as to N.A. Grishko for making some equipment data more precise.

Opinions and remarks should be directed to the "Svyaz'" publishing house at the following address: Moscow-Tsentr, Chistoprudnyy bul'var, 2.

Introduction

To provide for the transmission of all types of information in long distance service, provisions are made for the capability of organizing the following:

-- Standard voice frequency channels in a range of 0.3 - 3.4 KHz;

-- Broadcast channels in a range of 0.05 - 7 Khz and 0.03 - 10 KHz;

-- Preliminary group, wideband channels in a range of 12 - 24 KHz;

-- Primary wideband channels in a range of 60 - 108 KHz;

-- Secondary wideband channels in a range of 312 - 552 KHz;

-- Ternary wideband channels in a range of 812 - 2,044 KHz;

-- Television channels, etc.

The requirements placed on the various high frequency transmission systems differ both as regards the number of channels and the electrical parameters.

For this reason, bot existing and newly developed high frequency transmission systems should meet standard requirements for the organization of long distance service. A standard numeration and designation of the group routes and channels in high frequency transmission systems (Tables 1 - 4) have been introduced on the long distance network. The frequency spectra of the various HF transmission systems for open wire and cable trunks, which find wide application on the communications networks, and which are indicated in the following, are given in Figures 1 - 11.

TABLE 1. The Primary Groups (60 - 108 KHz) in the Main Spectrum of the Secondary Group (312 - 552 KHz) and in the Line Spectrum of the K-60 System (12 - 252 KHz).

1. Обозначение и нумерация первичных групп	2. Частота первичн. преобр., кгц	3. Спектр частот основной вторичной группы, кгц	4. Частота вторичн. преобр., кгц	5. Линейный спектр, кгц
P3-1 ПГ-1	420	312÷360		204÷252
PG-2 ПГ-2	468	360÷408		156÷204
PG-3 ПГ-3	516	408÷456	564	108÷156
PG-4 ПГ-4	564	456÷504		60÷108
PG-5 ПГ-5	612	504÷552		12÷60

Note: Within each primary group (60 - 108 KHz), the channels are numbered in order from the 1st to the 12th. In this case, the 108 KHz individual carrier frequency corresponds to the first channel, while the 64 KHz frequency corresponds to the 12th channel.

Key: 1. Designation and numeration of the primary groups;
2. Primary conversion frequency, KHz;
3. Frequency spectrum of the main secondary group, KHz;
4. Secondary conversion frequency, KHz;
5. Line spectrum, KHz.

TABLE 2. The Primary Groups (60 - 108 KHz) in the Line Spectrum of the K-24, K-24-2 and BK-24 Systems (12 - 108 KHz).

1. Обозначение и нумерация первичных групп	2. Частота преобразования кгц	3. Линейный спектр кгц
PG-4 ПГ-4	—	60÷108
PG-5 ПГ-5	120	12÷60

Key: 1. Designation and numeration of the primary groups;
2. Conversion frequency, KHz;
3. Line spectrum, KHz.

TABLE 3. The Secondary Groups (312 - 552 KHz) in the Line Spectrum of the K-300 System (60 - 1,300 KHz).

1. Обозначение и нумерация вторичных групп	2. Частота преобразования, кгц	3. Линейный спектр кгц
VG-1 ВГ-1	612	60÷300
VG-2 ВГ-2	0	312÷552
VG-3 ВГ-3	1116	564÷804
VG-4 ВГ-4	1364	812÷1052
VG-5 ВГ-5	1612	1060÷1300

Key: 1. Designation and numeration of the secondary groups;
2. Conversion frequency, KHz;
3. Line spectrum, KHz.

TABLE 4. The Secondary and Ternary Groups in the Line Spectrum of the K-1920 System for Radio Relay Links and Coaxial Cable

1. Обозначение и нумерация вторичных и третичных групп	2. Частота преобразования, кгц	3. Линейные спектры системы К-1920, кгц	
		4. по РРЛ	5. по коаксиальному кабелю
VG-0 ВГ-0	564	60÷252	—
VG-2 ВГ-2	0	312÷552	312÷552
VG-3 ВГ-3	1116	564÷804	564÷804
VG-4 ВГ-4	1364	812÷1052	812÷1052
VG-5 ВГ-5	1612	1060÷1300	1060÷1300
VG-6 ВГ-6	1860	1308÷1548	1308÷1548
ВГ-7	2108	1556÷1796	1556÷1796
ВГ-8	2356	1804÷2044	1804÷2044
TG-1 ТГ-1	0	(812÷2044) + + (60÷804)	(812÷2044) + + (312÷804)
TG-2 ТГ-2	4152	2108÷3340	2108÷3340
TG-3 ТГ-3	5448	3104÷4636	3104÷4636
TG-4 ТГ-4	6744	4700÷5932	4700÷5932
TG-5 ТГ-5	8040	5996÷7228	5996÷7228
TG-6 ТГ-6	9336	7292÷8524	7292÷8524

Notes: 1. Each ternary group consists of five secondary groups (VG-4 -- VG-8).
2. The K-1920 system has two secondary groups in addition (VG-2, VG-3).
3. The K-1920 system for a radio relay link has one more supplemental group (VG-0), and consists of eight secondary groups.
4. The zero secondary group for a radio relay link (in the 60 - 252 KHz spectrum) consists of four primary groups (48 channels).

Key: 1. Designation and numeration of the secondary and ternary groups;
2. Conversion frequency, KHz;
3. The line spectra of the K-1920 system, KHz;
4. Via a radio relay link;
5. Via a coaxial cable.

The most diverse types of information will be transmitted on the long distance communications network. For this reason, in selecting a transmission system for one route or another, as well as when evaluating the capability of carrying information of the specified form and volume on already existing communications lines, it is necessary to know the maximum permissible number of channels which can be engaged when transmitting various types of information in the group and line channels of the transmission systems.

Given in Tables 5 - 10 are the variants of the loading of group channels and transmission systems having different numbers of channels.

TABLE 5. Variants of the Maximum Permissible Loading for 300-Channel Groups in Systems with 300 - 2,700 Channels (with the Exception of the K-1920 System).

Наименование каналов 1.	Form of the Information Вид информации	2. Средняя мощность в канале		3. Максимальная мощность в канале	
		Micro watts мкат	Nepers неп	Micro watts мкат	Nepers неп
Voice Frequency Тональной частоты	4. Телефонирование	32	—1,73	2220	0,4
	5. Тональное телеграфирование ЧМ	135	—1,0	2220	0,4
	6. Фототелеграфирование ЧМ FM АМ AM	100 360 (1000 ср. мощ. за мин.) (15)	—1,15 —0,5 0	200 1000	—0,8 0
	7. Передача данных	50 100	—1,5 —1,15	125 250	—1,04 —0,69
8. Объединенная полоса трех каналов тч	Вещание Broadcast	16. См. прим. 5		8000	1,04
9. Предгрупповой	Передача данных 12.	96	—1,17	350	—0,5
10. Первичный	Передача данных или 13. передача газет	384	—0,5	1000	0
11. Вторичный	Передача данных или 14. передача газет	1920	0,33	2720	0.5

TABLE 5 [Continued]

	Количество каналов тональной частоты для различных вариантов загрузки 17.								Предгрупповые 18.		Первичные Primary		Вторичные Secondary	
	I		II		III		IV							
	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во
4.	66,7	(19) 200	84,8	(19) 254	77,1	(19) 231	54,8	(19) 164	—	(19) —	—	(19) —	—	(19) —
5.	2,2	7	2,2	7	2,2	7	2,2	7	—	—	—	—	—	—
6. FM/AM	—/1	—/3	—/1	—/3	1/—	3/—	1/—	3/—	—/—	—/—	—/—	—/—	—/—	—/—
7.	28/—	84/—	—/10	—/30	—/17,7	—/53	40/—	120/—	—/—	—/—	—/—	—/—	—/—	—/—
8.	2	6	2	6	2	6	2	6	—	—	—	—	—	—
9.	—	—	—	—	—	—	—	—	100	100	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	100	25	—	—
11.	—	—	—	—	—	—	—	—	—	—	—	—	100	5

Notes: 1. For systems with 300 - 2,700 channels (with the exception of the K-1920 system, the average design power is 50 microwatts for one channel at the point of the relative zero level;

2. For systems with more than 2,700 channels, the average design power for the information signals being transmitted, referenced to one voice frequency channel, should be no less than 40 microwatts;

3. The maximum permissible number of voice frequency channels, engaged with the transmission of different types of information in the K-1920 system, is given in Table 10;

4. For groups and systems with 300 channels, the maximum average power for an hour is 15 milliwatts (1.3 Nepers) and 19 milliwatts (1.5 Nepers) for a minute, at the point of the relative zero level.

5. The average broadcast signal power level at the point of the relative zero level is: for an hour, 923 microwatts (-0.04 Nepers); for a minute, 2,230 microwatts (0.4 Nepers); and for a second, 4,500 microwatts (0.75 Nepers).

Key: 1. Designation of the channels;
2. Average power in a channel;
3. Maximum power in a channel;
4. Telephony;

[Key to Table 5, continued]:

5. Audio frequency FM telegraphy;
6. Facsimile;
7. Data transmission;
8. Combined passband of three voice frequency channels;
9. Pre-group;
10. Primary;
11. Secondary;
12. Data transmission;
13. Data transmission or newspaper transmission;
14. "
15. (1,000 is the average power for a minute);
16. See note 5;
17. Number of voice frequency channels for the different loading variants;
18. Pre-group;
19. Number.

In the "average power in a channel" column of these tables, the average signal power is given referenced to the point of the zero relative level. Indicated in the "maximum power" column is the permissible maximum power (effective value) of the signal. The average power of a facsimile signal with AM and FM is given in the table for the period of an hour, while given in parentheses is the maximum possible average AM facsimile power over a minute.

In determining the permissible loading on any 12, 60 and 300 channel groups, to be taken into account is the fact that the overall loading of the groups of a higher order and the line channels of the transmission system as a whole does not exceed the permissible value. Where it is necessary to load group channels or a transmission system in a variant other than that given in the tables shown here, to be taken into account is the fact that for a voice frequency channel, and primary and secondary channels, the average value of the signal powers were derived by working from the MKTT [International Committee on Telephony and Telegraphy] recommendations (G = 222), which establish the average powers of multichannel signals used in the calculations for multichannel systems. These power values do not characterize the signal powers of an individual subscriber, but are the average design figures for the power in a channel, characteristic for a group in 12, 60, 300 and more channels when transmitting telephone information through them. For this reason, the average signal power indicated in a table for one telephone transmission for the pre-group (600 microwatts), primary (179 microwatts) and secondary (66.7 microwatts) channels in HF systems where the number of channels is less than 240 cannot be used as the design figure in determining the number of channels for another type of information, even if the magnitude of the average power of this type of information coincides with the telephone transmission signal power.

TABLE 6. Variants of the Maximum Permissible Loading for Groups and Systems with 60 Channels

Наименование каналов 1.	Form of the Information Вид информации	Средняя мощность в канале 2. Micro watts мквт	неп Nep.	Максимальн. мощность в канале 3. Micro watts мквт	неп Nep	Количество каналов вариантов 17. I %	I к-во	II %	II к-во	III %	III к-во
Voice Frequency Тональной частоты	4. Телефонирование	66,7	—1,35	2220	0,4	65	(19) 39	60	19 36	50	19 30
	5 Тональное телеграфирование ЧМ	135	—1,0	2220	0,4	23,3	14	30	18	50	30
	6. Фототелеграфирование ЧМ AM (15)	FM 100 AM 360 (1000 ср. мощ. за мин.)	—1,15 —0,5 0	200 1000	—0,8 0	— 1,7	— 1	— —	— —	— —	— —
	7. Передача данных	50 100	—1,5 —1,15	125 250	—1,04 —0,69	— —	— —	— —	— —	— —	— —
8. Объединенная полоса трех каналов тч	Вещание Broadcast	См. прим. 4 16.		8000	1,04	10	6	10	6	—	—
9. Предгрупповой	12. Передача данных	96	—1,17	350	—0,5	—	—	—	—	—	—
10. Первичный	13. Передача данных или передача газет	384	—0,5	1000	0	—	—	—	—	—	—
11. Вторичный	14. Передача данных или передача газет	1920	0,33	2720	0,5	—	—	—	—	—	—

Notes: 1. For the K-1920 system, the maximum average power in the 60-channel group should not exceed 6.0 mw (0.9 Np) over an hour, and 8.0 mw (1.04 Np) over a minute.

2. For the existing K-60 and K-60p [transistorized] systems for multiplexing a balanced cable, the transmission of broadcast programs is permitted in any two of three primary groups (3, 4, and 5). In this case, to assure the crosstalk isolation of systems operating in parallel, the pairs should be specially chosen. The number of broadcast channels organized in primary groups of the same designation as those of parallel operating systems on the same cable should not exceed four for MKSB 4 x 4 and MKSB 7 x 4 cables.

[TABLE 6, continued]

тональной частоты для различных загрузки 17.								18. Предгрупповые		Primary Первичные		Secondary Вторичные		
IV		V		VI		VII								
%	К-во	%	К-во	%	К-во	%	К-во	%	К-во	%	К-во	%	К-во	
65	19. 39	65	19. 39	—	19. —	50	19. 30	—	19. —	—	19. —	—	19. —	(4)
30	18	26,7	16	—	—	—	—	—	—	—	—	—	—	(5)
—	—	—	—	—	—	8,3	5	—	—	—	—	—	—	(6) FM
5	3	3,3	2	—	—	—	—	—	—	—	—	—	—	AM
— —	— —	— —	— —	100 —	60 —	— 11,7	— 25	— —	— —	— —	— —	— —	— —	(7)
—	—	5	3	—	—	—	—	—	—	—	—	—	—	
														Broadcast
—	—	—	—	—	—	—	—	100	20	—	—	—	—	(9) (12)
—	—	—	—	—	—	—	—	—	—	100	5	—	—	(10) (13)
—	—	—	—	—	—	—	—	—	—	—	—	100	1	(11) (14)

[Notes to Table 6, continued]:

3. For 60-channel balanced cable systems, the average power being transmitted in the wideband secondary channel should be reduced down to 384 microwatts, in view of the inadequate crosstalk isolation between the cable pairs.

4. The average broadcast signal power level at the point of the relative zero level is: for an hour, 923 microwatts (0.04 Np); for a minute, 2,230 microwatts (0.4 Np), and for one second, 4,500 microwatts (0.75 Np).

[Key to Table 6]:

1. Designation of the channels;
2. Average power in a channel;
3. Maximum power in a channel;
4. Telephony;
5. Audio frequency FM telegraphy;
6. Facsimile;
7. Data transmission;
8. Combined passband of three voice frequency channels;
9. Pre-group;
10. Primary;
11. Secondary;
12. Data transmission;

13, 14. Data transmission or newspaper transmission;

15. (1,000 [μw] is the average power for a minute);
16. See note 4;
17. Number of voice frequency channels for the different loading variants;
18. Pre-group;
19. Number.

In terms of its function, long distance communications equipment is broken down into the following:

-- Input, test and switching equipment;

-- Transmission system equipment;

-- Low frequency amplifying equipment;

-- Broadcast equipment;

-- Auxiliary;

-- Measurement.

While transmission equipment with a small number of channels (up to 12 channels) has been developed as regards its structural design and equipment complement, it is not being developed individually for each system, and for multichannel systems with more than 12 channels, the individual equipment, the primary and secondary conversion equipment, as well as the generator equipment, as noted above, are being developed, taking into account the standardization of the common components. For this reason, given in ths handbook are the main technical data for this equipment in the individual sections, to which a reference is given when considering the equipment package for multichannel system transmission equipment.

All of the channel generating and auxiliary equipment is housed in special rooms, line equipment shops (or rooms), LATs. Depending on the type of circuits brought into them, LATs's are broken down into open wire, cable and mixed types.

TABLE 7. Variants of the Maximum Permissible Loading for Groups and Systems with 12 Channels

Наименование каналов 1.	Form of the Information Вид информации	Средняя мощность 2. в канале		Максимальная мощность 3. в канале		Количество каналов 15. различных			
		Micro-watts мквт	неп Np	Micro watt мквт	неп Np	I %	I к-во	II %	II к-во
Voice Тональной частоты Frequency	Телефонирование 4.	179	—0,86	2220	0,4	66,7	16. 8	75	16. 9
	5. Тональное телеграфирование ЧМ	135	—1,0	2220	0,4	8,3	1	16,7	2
	6. Фототелеграфирование ЧМ FM АМ AM (13)	100 300 (1000 ср. мощ. за мин.)	—1,15 —0,5 0	200 1000	—0,8 0	— —	— —	— 8,3	— 1
	Передача данных 7.	50 100	—1,5 —1,15	125 250	—1,04 —0,69	— —	— —	— —	— —
8. Объединенная полоса трех каналов тч	Вещание Broadcast	См. прим. 1 14.		8000	1,04	25	3	—	—
Предгрупповой 9.	Передача данных 11.	96	—1,17	350	—0,5	—	—	—	—
Первичный 10.	Передача данных или передача газет 12.	384	—0,5	1000	0	—	—	—	—

Notes: 1. The average broadcast signal power level at the point of the relative zero level is: for an hour, 923 microwatts (0.04 Np); for a minute, 2,230 microwatts (0.4 Np); and for a second, 4,500 microwatts (0.75 Np).

2. The maximum average power is 3.0 mw (0.55 Np) for an hour, and 4.0 mw (0.7 Np) for a minute at the point of the relative zero level.

Key: 1. Designation of the channels;
2. Average power in a channel;
3. Maximum power in a channel;
4. Telephony;
5. Audio frequency FM telegraphy;
6. Facsimile;
7. Data transmission;

[TABLE 7, continued]

тональной частоты для вариантов загрузки 15.							Предгрупповые 17.		Первичные Primary		
III		IV		V							
%	к-во	%	к-во		%	к-во	%	к-во	%	к-во	
50	16. 6	—	16.	50	6	16.	—	—	—	—	(4)
50	6	—	—	—	—	—	—	—	—	—	(5)
											(6)
—	—	—	—	8,3	1	—	—	—	—	—	FM
—	—	—	—	—	—	—	—	—	—	—	AM
—	—	100	2	—	—	—	—	—	—	—	(7)
—	—	—	—	41,7	5	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	—	(8)
—	—	—	—	—	—	100	4	—	—	—	(9) (11)
—	—	—	—	—	—	—	—	100	1	—	(10) (12)

[Key to Table 7, continued]:

8. The combined passband of three voice frequency channels;
9. Pre-group;
10. Primary;
11. Data transmission;
12. Data transmission or newspaper transmission;
13. (1,000 [μw] is the average power for a minute);
14. See note 1;
15. Number of voice frequency channels for the different loading variants;
16. Number;
17. Pre-group.

TABLE 8. Variants of the Maximum Permissible Loading for Groups and Systems with Three Channels.

Наименование каналов 1.	Form of the Вид информации Information	Средняя мощность в канале 2.		Максимальная мощность в канале 3.		Количество 4.	
		Micro- мквт watts	нeп Nepers	Micro мквт watt	нeп Nep	I	
						%	к-во 11.
Voice Frequency Тональной частоты	5. Телефонирование	600	—0,25	2220	0,4	100	3
	Тональное телеграфирование ЧМ 6.	135	—1,0	2220	0,4	—	—
	Фототелеграфирование 7. ЧМ FM АМ AM	100 360 (1000 ср. мощ. за мин.) (8)	—1,15 —0,5 0	200 1000	—0,8 0	— —	— —
	Передача данных 9.	50 100	—1,5 —1,15	125 250	—1,04 —0,69	— —	— —
10. Предгрупповой	Передача данных 9.	96	—1,17	350	—0,5	—	—

[TABLE 8, continued]:

4. каналов тональной частоты для различных вариантов загрузки												Предгрупповые Pregroup		
II		III		IV		V		VI		VII				
%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	
33	11 1	—	11. —	67	11. 2	33	11. 1	67	11. 2	67	2	—	—	(5)
—	—	—	—	33	1	67	2	—	—	—	—	—	—	(6)
— —	— —	— —	— —	— —	— —	— —	— —	— 33	— 1	33 —	1 —	— —	— FM — AM	(7)
— 67	— 2	100 —	3 —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	(9)
—	—	—	—	—	—	—	—	—	—	—	—	100	1	(9) (10)

Note: The maximum average power is 2.7 mw (0.51 Np) over an hour, and 3.5 mw (0.65 Np) over a minute at the point of the relative zero level.

Key: 1. Designation of the channels;
2. Average power in a channel;

[Key to Table 8, continued]:

3. Maximum power in a channel;
4. Number of voice frequency channels for the different loading variants;
5. Telephony;
6. Audio frequency FM telegraphy;
7. Facsimile;
8. (1,000 is the average power for a minute);
9. Data transmission;
10. Pre-group.

In terms of their functional purpose, there are the following types of LATs [Line equipment shops]:

-- Terminal network stations for cable and open-wire communications lines;

-- Terminal and through-working network junctions;

-- Attended repeater stations of transmission systems.

Moreover, part of the channel generating equipment can be installed at terminal (ORS) and junction (URS) stations of radio relay links*.

For purposes of improving the operation of the system, substantial changes have been introduced into the construction principles of line equipment shops in accordance with a decree of the USSR Ministry of Communications, where these changes reduce basically to the fact that line equipment shops are broken down into two main services: the equipment service for high frequency channels (ST-LATs), and channel service (SK-LATs).

Housed in the ST-LATs is the line channel equipment (including the entrance units), the primary, secondary and ternary conversion equipment with its generator equipment, as well as the auxiliary equipment. Housed in the SK-LATs is the individual conversion equipment, the low frequency amplifier equipment, broadcast equipment, test and switching equipment, as well as the auxiliary gear. For large scale line equipment shops, the ST-LATs and SK-LATs services are, as a rule, housed in separate adjacent rooms.

The equipment is installed in the LATs in parallel rows, perpendicular to the main passageway. Depending on the width of the LATs room, the rows are arranged along one or both sides of the main passageway. Two main types of equipment, intended for installation in the LATs of attended stations, are produced, according to its structural design:

-- In frames made of channel or angle steel with two-sided or one-sided

* The basic principles for the design and installation of line equipment shops are set forth in TU [Technical Specifications] 324-60 of the USSR Ministry of Communications and the "Ukazaniya po montazhu stantsionnogo oborudovaniya mezhdugorodnoy provodnoy svyazi, ch. I. Lineyno-apparatnyye tsekha" ["Instructions for the Installation of Long Distance Wire Communications Station Equipment. Part I. Line Equipment Shops"], Svyaz' Publishers, 1964.

placement of the boards, and internal rack wiring, which is brought out to terminals installed in the upper part of the racks or directly to the boards. The height of such racks is 2,500 mm, the width is 650 mm or 530 mm, and the depth from 250 to 500 mm, depending on the type of equipment;

— In frames of a special bent profile, 2,600 mm high, 650 mm wide and 250 mm deep (the so-called base structure). Besides the mainframe with a height of 2,600 mm, frames are authorized with dimensions of 1/2, 1/3 and 1/4 the main height. Equipment of this structural design has one-sided placement of the panels with a blank rear wall. The intrarack wiring is accomplished along the walls and in troughs; the tying of the panels and blocks into the troughs is realized by means of notched blocks.

TABLE 9. Variants of the Maximum Permissible Loading for Groups and Systems with 120 Channels.

1. Наименование каналов	Form of the Вид информации Information	Средняя мощность в канале 2.		Максимальная мощность в канале 3.		Количество 4.	
		мквт	неп	мквт	неп	%	к-во
Voice Frequency Тональной частоты	5. Телефонирование	50,0	—1,5	2220	0,4	57,5	69
	6. Тональное телеграфирование ЧМ	135	—1,0	2220	0,4	3,3	4
	7. Фототелеграфирование ЧМ FM	100	—1,15	200	—0,8	—	—
	АМ AM	360 (1000 ср. мощн. (8) за мин.)	—0,5 0	1000	0	2,5	3
	Передача данных 9.	50 100	—1,5 —1,15	125 250	—1,04 —0,69	31,6 —	38 —
10. Объединенная полоса трех каналов ТЧ	Вещание Broadcast	См. прим. 1 15.		8000	1,04	5	6
11. Предгрупповой	Передача данных 9.	96	—1,17	350	—0,5	—	—
12. Первичный	Передача данных 14 или передача газет	384	—0,5	1000	0	—	—
13. Вторичный	Передача данных 14 или передача газет	1920	0,33	2720	0,5	—	—

Notes: 1. The average broadcast signal power level at the point of the relative zero level is: for an hour, 923 microwatts(-0.04 Np); for a minute, 2,230 microwatts (0.4 Np); and for one second, 4,500 microwatts (0.75 Np).

TABLE 9. [continued]:

	каналов тональной частоты для различных вариантов загрузки 4.								Прегруп-повые Pregroup		Primary Первичные		Вторичные Secondary	
	II		III		IV		V							
	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во
(5)	75	90	55	66	75	90	65,1	78	—	—	—	—	—	—
(6)	3,3	4	—	—	15	18	—	—	—	—	—	—	—	—
(7) FM	16,7	20	8,4	10	—	—	3,3	4	—	—	—	—	—	—
(7) AM	—	—	—	—	—	—	—	—	—	—	—	—	—	—
(9)	—	—	31,6	38	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	31,6	38	—	—	—	—	—	—
Broadcast	5	6	5	6	10	12*	—	—	—	—	—	—	—	—
(11)	—	—	—	—	—	—	—	—	100	40	—	—	—	—
(12)	—	—	—	—	—	—	—	—	—	—	100	10	—	—
(13)	—	—	—	—	—	—	—	—	—	—	—	—	100	2

[Notes to Table 9, continued]:

2. The maximum average power is 10 mw (1.15 Np) for an hour and 13.5 mw (1.3 Np) for a minute at the point of the relative zero level.

Key: 1. Designation of the channels;
2. Average power in a channel;
3. Maximum power in a channel;
4. Number of voice frequency channels for the different loading variants;
5. Telephony;
6. Audio frequency FM telegraphy;
7. Facsimile;
8. (1,000 is the average power for a minute);
9. Data transmission;
10. The combined passband of three voice frequency channels;
11. Pre-group;
12. Primary;
13. Secondary;
14. Data transmission or newspaper transmission;

* A provision is made for four simplex broadcast channels for a system with a common amplifier.

TABLE 10. Variants of the Maximum Permissible Loading for the K-1920 System

Наименование каналов 1.	Form of the Вид информации Information	Средняя мощность в канале 2.		Максимальная мощность в канале 3.		Количество вариантов 4.	
		Micro-watts мкВт	Nepers неп	Micro Watt мкВт	Nep неп	I %	I к-во
Voice Frequency Тональной частоты	5. Телефонирование	32	—1,73	2220	0,4	96	(15) 1845
	Тональное телеграфирование ЧМ 6.	135	—1,0	2220	0,4	2,1	40
	Фототелеграфирование ЧМ FM 7. АМ AM (9)	100 360 (1600 ср. мощн. за мин.)	—1,15 —0,5 0	200 1000	—0,8 0	— 0,3	— 5
	Передача данных 8.	50 100	—1,5 —1,15	125 250	—1,04 —0,69	— —	— —
10. Объединенная полоса трех каналов тч	Вещание Broadcast	См. прим. 4 See Note 4.		8000	1,04	1,6	30
11. Предгрупповой	Передача данных 12.	96	—1,17	350	—0,5	—	—
13. Первичный	Передача данных 14 или передача газет	334	—0,5	1000	0	—	—
15. Вторичный	Передача данных 14 или передача газет	1920	0,33	2720	0,5	—	—

Notes: 1. For the K-1920 system, the maximum average power for an hour should not exceed 74 mw at the point of the relative zero level.

2. The maximum average power level of the load of the individual groups at the point of the relative zero level should not exceed the following: for a 300-channel group, 12 mw; for a 60-channel group, 6 mw; for a 12-channel group, 3 mw. In one 60-channel group, it is permissible to transmit no more than one broadcast program via tripled and doubled telephone channels, and in one 300-channel group, no more than two broadcast programs. When determining the permissible load for any 12, 60 or 300 channel group, one should proceed from the fact that the overall load of the groups of a higher order (the 60 and 300 channel groups), as well as for the line channel as a whole, should not exceed 74 mw.

3. With the combined transmission of telephone signals and television signals, it is permissible to organize no more than five broadcast channels simultaneously.

4. The average broadcast signal power level at the point of the relative zero level is: for one hour, 923 microwatts (-0.04 Np), for a minute, 2,230 microwatts (0.4 Np); and for a second, 4,500 microwatts (0.75 Np).

[TABLE 10, continued]:

	каналов тональной частоты для различных загрузки 4.						Предгрупповые Pregroup		Первичные Primary		Вторичные Secondary		
	II		III		IV								
	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	%	к-во	
(5)	91,7	(15) 1762	92,65	(15) 1776	81,5	1567	—	—	—	—	—	—	
(6)	0,7	13	0,7	13	0,7	13	—	—	—	—	—	—	
(7)	0,05	1	—	—	0,3	5	—	—	—	—	—	—	FM
	—	—	0,05	1	—	—	—	—	—	—	—	—	AM
(8)	— 5,95	— 114	— 5	— 100	15,9 —	305 —	— —	— —	— —	— —	— —	— —	
(10)	1,6	30	1,6	30	1,6	30	—	—	—	—	—	—	
(11)	—	—	—	—	—	—	100	640	—	—	—	—	
(13)	— (14)	—	—	—	—	—	—	—	100	160	—	—	
(15)	— (14)	—	—	—	—	—	—	—	—	—	100	32	

Key:
1. Designation of the channels;
2. Average power in a channel;
3. Maximum power in a channel;
4. Number of voice frequency channels for the different load variants;
5. Telephony;
6. Audio frequency FM telegraphy;
7. Facsimile;
8. Data transmission;
9. (1,000 is the average power for a minute);
10. The combined passband of three voice frequency channels;
11. Pre-group;
12. Data transmission;
13. Primary;
14. Data transmission or newspaper transmission;
15. Secondary.

Racks of this design can be installed in twin rows with their backs to each other, or directly against a wall.

At the present time, the base structure has been modernized, taking into account the requirements of the CCITT and the CEMA. The overall dimensions of the new base structure are 2,600 x 600 x 225 mm.

The structural design of the equipment for unattended repeater points (NUP) is individual for each multiplex system and is designed for housing the equipment either in underground metal chambers (of the horizontal or vertical type), or in special housings, buried directly in the ground.

The NUP metal containers of the horizontal and vertical types provide for access into them, by virtue of their dimensions, where this is necessary for the servicing personnel. Access to the equipment of an NUP installed in a housing which is buried directly in the ground is accomplished from the surface of the ground.

The NUP equipment of the K-24p-2m, K-60p-4 and K-300 types are structurally designed in the form of containers (blocks), which are installed in a package buried directly in the ground.

At attended line equipment shops, the securing of the bays to each other in rows is accomplished by means of 50 x 50 x 5 angle irons, to which the bay frames are fastened with two bolts. The rows of equipment are secured together by trunk strips with a cross-section of 30 x 8 mm, which are fitted in the corners of the rows in pairs on a rib and secured to it by means of special screw clamps.

Line cables are brought into a line equipment shop and station cables are run between the bays using open air metal channels, which are subdivided into row types, arranged over the rows of bays, and trunk types, running perpendicular to the rows above the bays along the line equipment shop. At the present time, open air channels made of strip steel of a welded construction or with movable rods are used for running the cables in line equipment shops. The standard dimensions of such channels are set by GOST 13321-67. The width of the channels is chosen in accordance with the size of the cable bundle. A measurement equipment complex is necessary for the normal operation of long distance channels and equipment, installed in line equipment shops.

The equipment of attended trunk line stations (OP's, OUP's, etc.) is electrically powered from local (autonomous) electrical power plants. The equipment of unattended stations (NUP's) [unattended repeater stations], as a rule, is supplied with electrical power remotely, by means of feeding the appropriate voltage via the working pairs of a cable and open wire circuits from the attended stations. Depending on the communications system and the type of equipment, DC or AC sources are used for its electrical power supply. The electrical power supply system using direct current for the equipment has become the most widespread. At the present time, alternating current electrical power supply is used on the long distance communications network practically only for the K-1920 system.

For this purpose, the K-1920 system at attended stations on trunks are equipped with guaranteed AC plants (three machine sets or other similar equipment), and

at the unattended repeater stations, the remote power is fed via the central cores of the coaxial pairs of a cable using alternating current at voltages up to 2,000 volts.

The requirements placed on the electrical power plants for communications enterprises and the norms for their design are set forth in TU 326-60 of the USSR Ministry of Communications.

The voltage levels fed to the equipment for the electrical power supply depend on whether vacuum tubes, semiconductors and other components which require electrical power are present in it.

The levels of these voltages are specified by GOST 5237-69 (Tables 11, 12).

TABLE 11. DC Voltages of the Electrical Power Supplies of Long Distance and Junction Line Transmission Equipment.

Designation of the Equipment and Circuits	Voltage of the Current Source in volts		Permissible Voltage Ripple Produced by the Current Source in volts, no more than:	
	Nominal	Permissible Range of Variation	Measured with a VTVM with a mean square scale	Measured with a psophometer
1. Long distance communications equipment:				
-- Filament circuits for vacuum tube equipment	21.2	20.6 - 21.8	3	-
-- The same, for plate circuits[2]	206	200 - 212	$250\cdot10^{-3}/15\cdot10^{-3}$	-
-- Supply circuits for transistorized gear	24 21.2[1]	21.6 - 26.4 20.6 - 21.8	$250\cdot10^{-3}/15\cdot10^{-3}$	
-- Auxiliary circuits (signal circuits, etc.)	24	21.6 - 26.4	1.2	
2. Transmission equipment of municipal ATS junction lines	60	58 - 66 58 - 64[1,3]	-	$5\cdot10^{-3}$
3. The same, for rural ATS's	60	54 - 72	-	$5\cdot10^{-3}$

1 Permitted for equipment developed prior to 1 January 1970;

2 The permitted pulsation, indicated in the numerator, is measured in a range of up to 300 Hz, and in the denominator, in a frequency range of up to 300 Hz and above;

3 When the standby power source is switched in, a voltage increase up to 66 volts is permitted.

[ATS = Automatic Telephone Exchange]

TABLE 12. The Phase Voltages of the Alternating Current (50 Hz) (in Both a Single-Phase and a Three-Phase System), Delivered to the Equipment.

Alternating Current Source Источник переменного тока	1. Напряжение источника тока, в Nominal номинальное	2 допускаемые пределы изменения	3. Допускаемые пределы колебания частоты, гц
General Service Electrical Power Network Электросеть общего пользования	220	187÷242	48÷52
	127	108÷140	
4. Собственные устройства проектированного переменного тока и электростанций предприятий связи	220	213÷227	
	127	123÷131	

Key: 1. Voltage of the current sources, volts;
2. Permissible range of variation;
3. Permissible range of frequency fluctuation, Hz;
4. In-house devices for the design alternating current and the electrical power plants of communications enterprises.

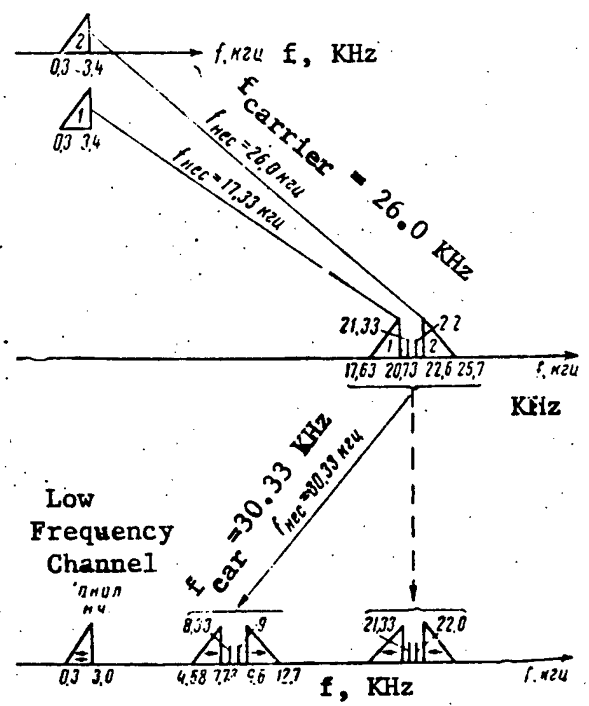


Figure 1.

The generation of the line frequency spectrum in the V-2 system.

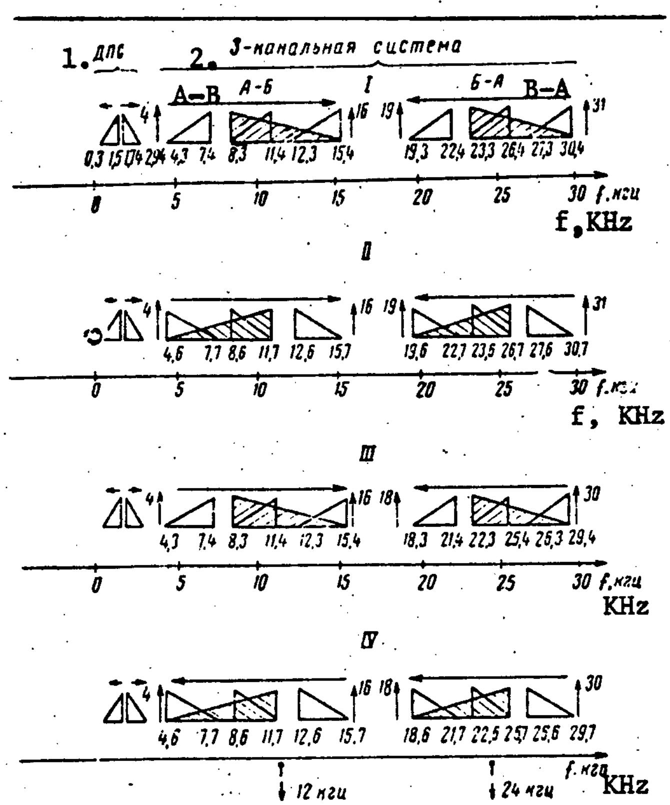


Figure 2. The generation of the line frequency spectrum in the V-3-3 (or V-3-3s) system.

Key: 1. Remote power supply and signaling.

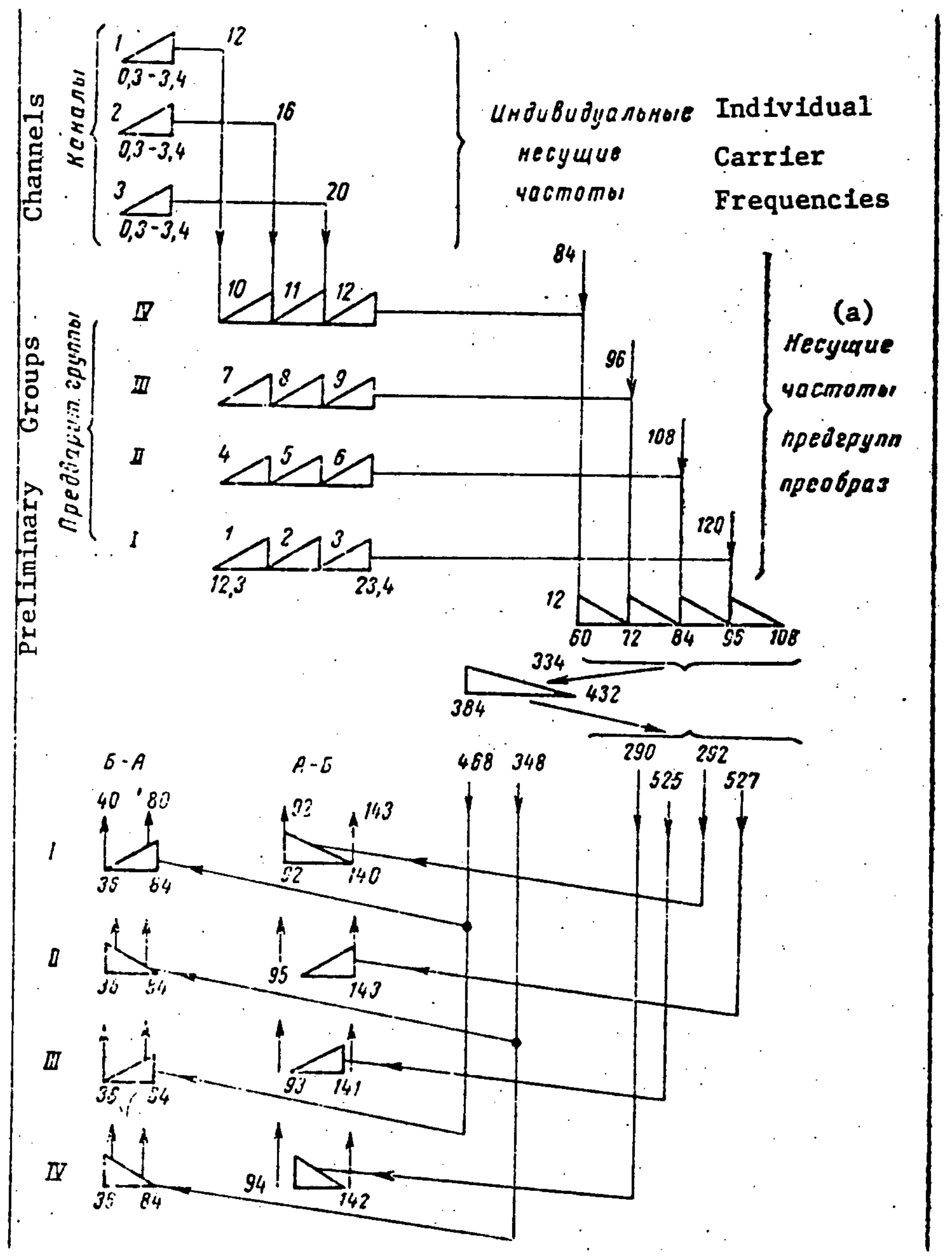


Figure 3. The generation of the line frequency spectrum in the V-12-3 system.

Key: (a) Carrier frequencies of the conversion preliminary groups.

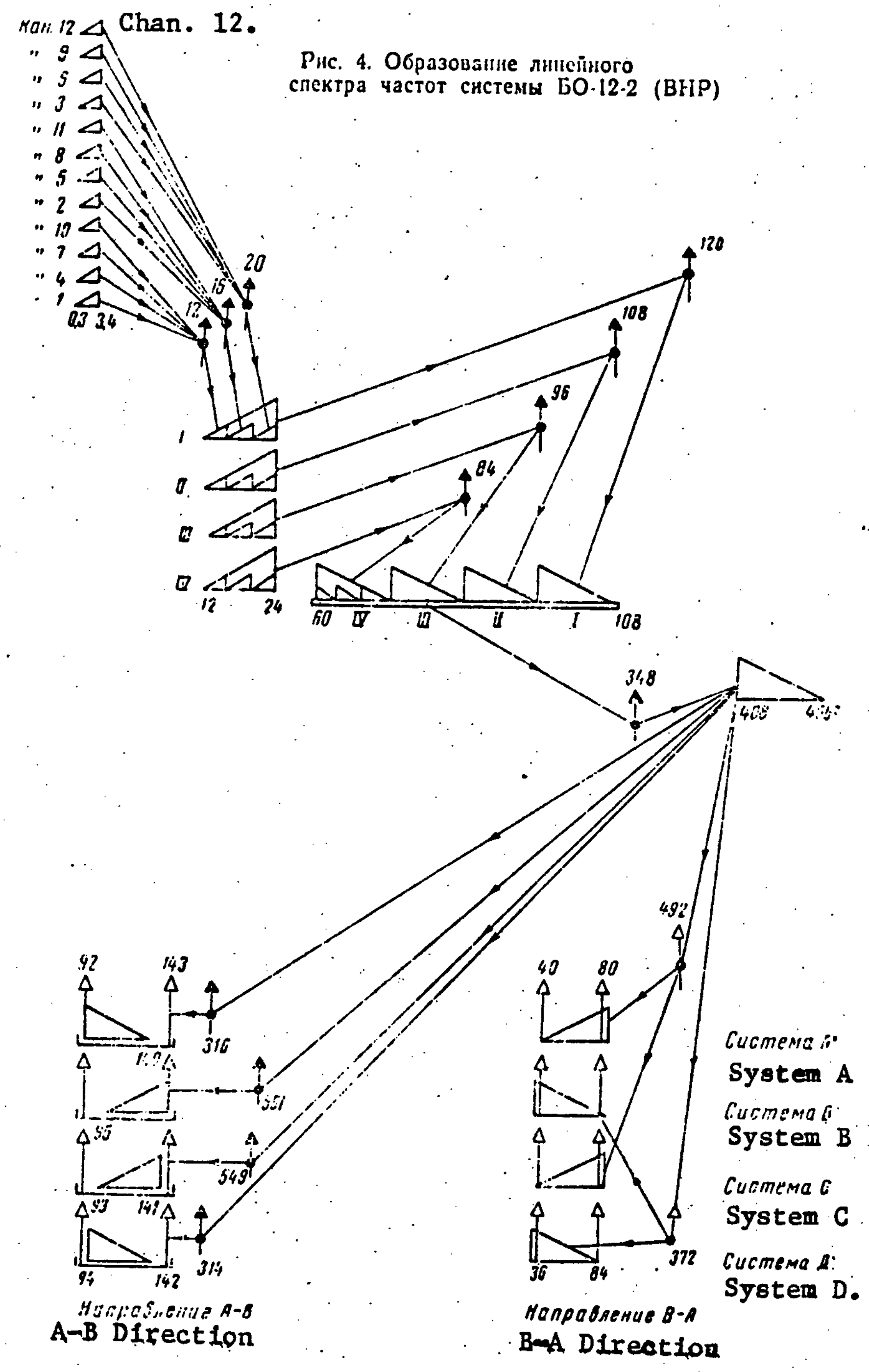


Figure 4. The generation of the line frequency spectrum in the BO-12-2 system (Hungarian People's Republic).

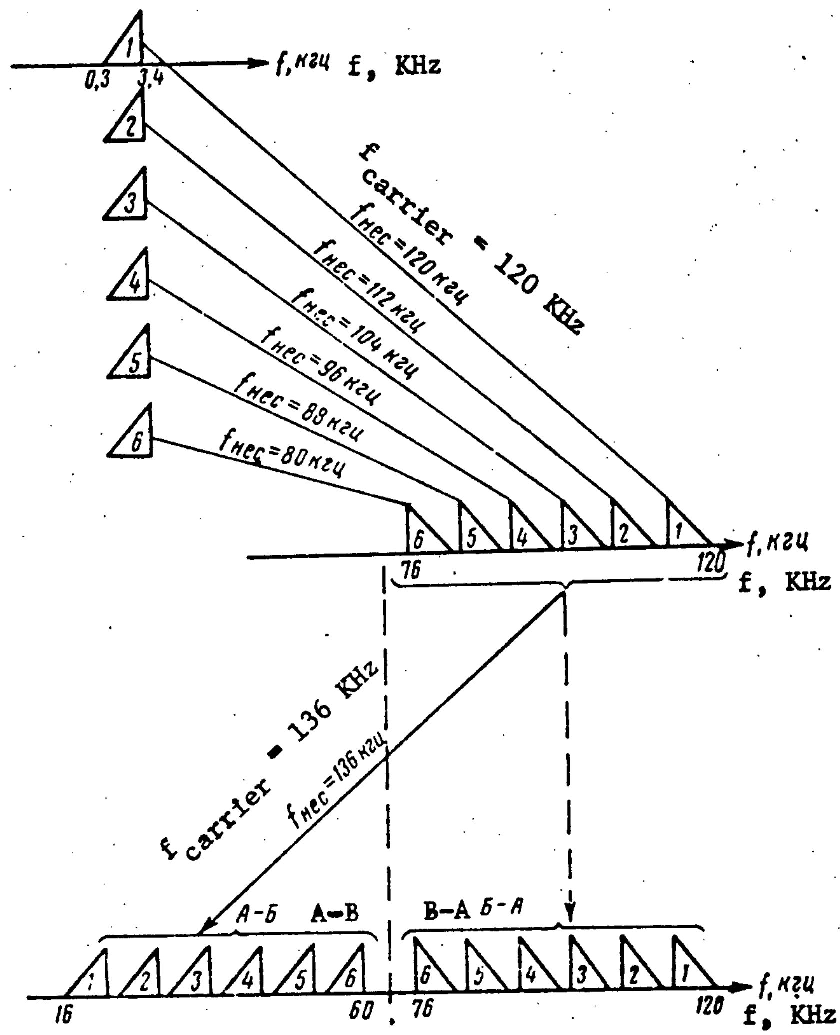


Figure 5. The generation of the line frequency spectrum of the KNK-6s system.

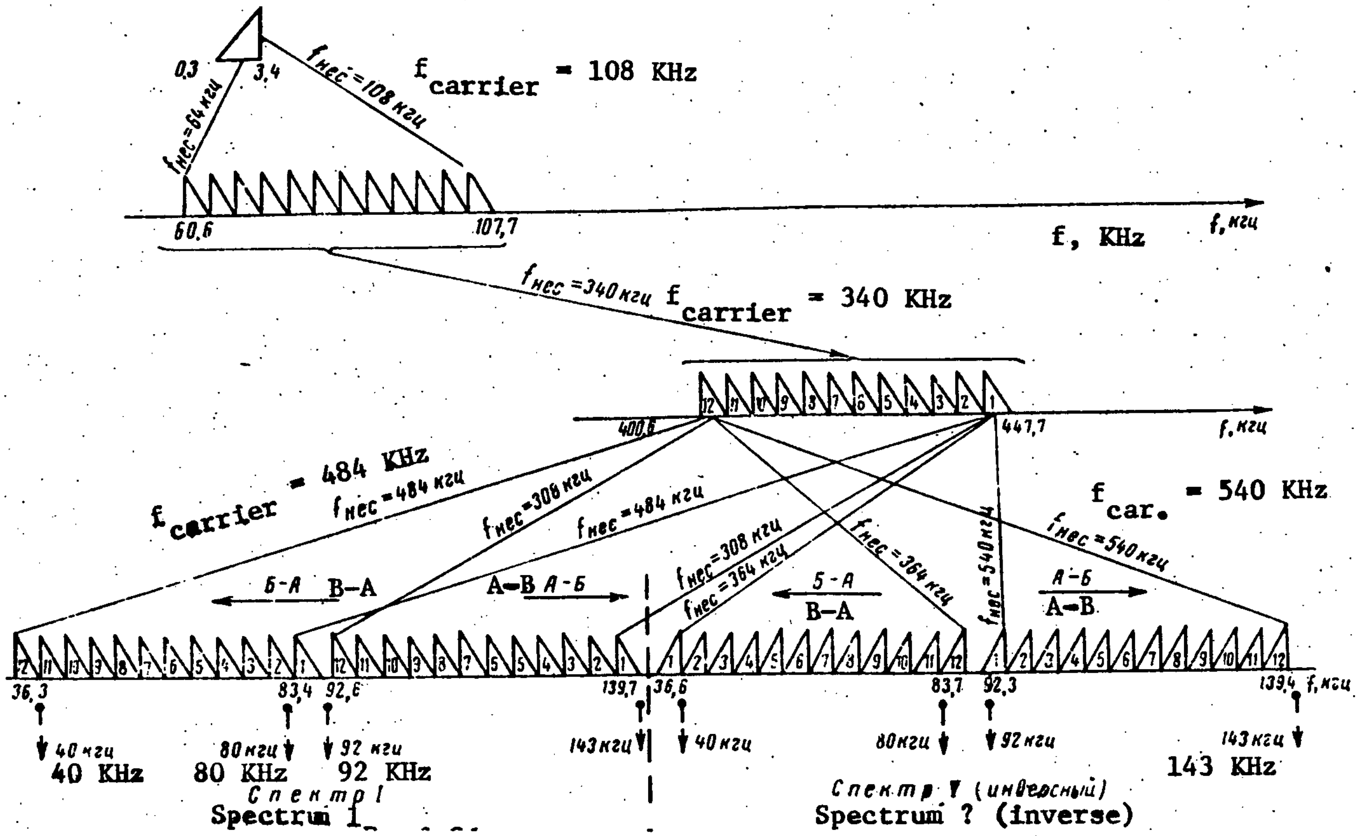


Figure 6. The generation of the line frequency spectrum of the KV-12 system.

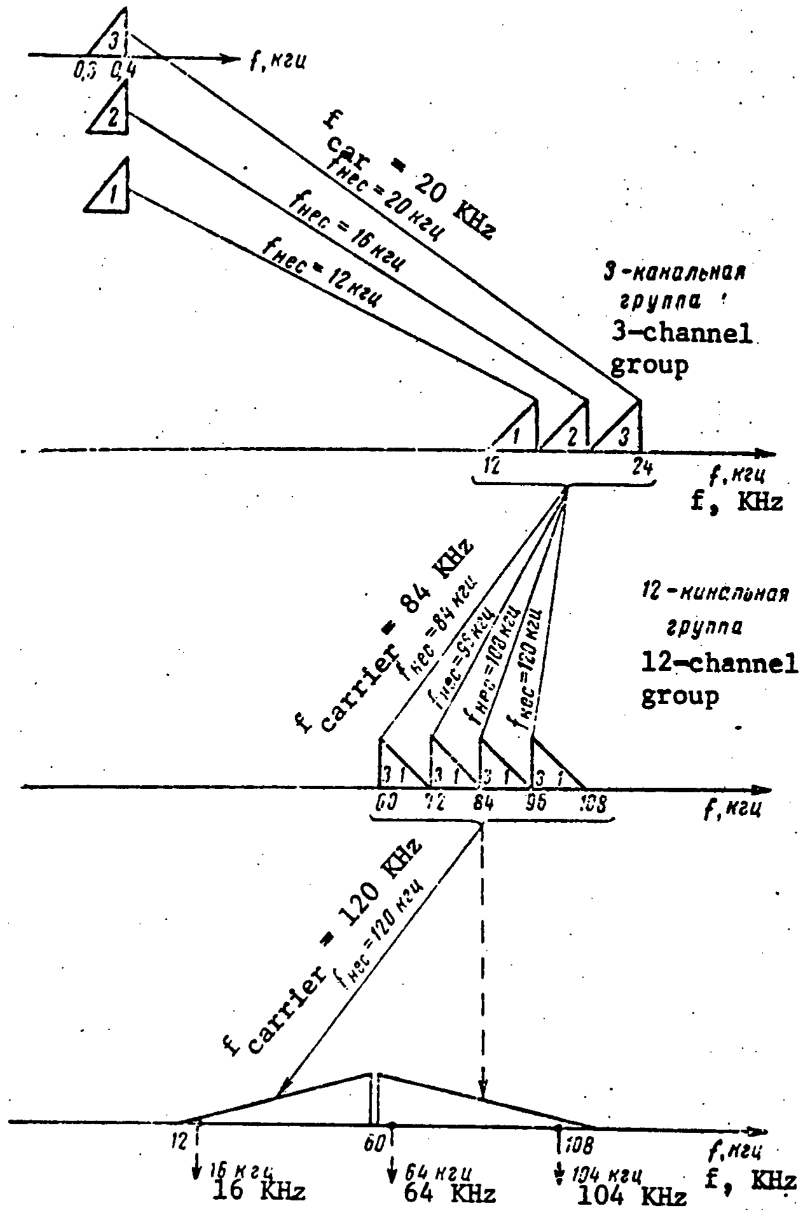


Figure 7. The generation of the line frequency spectrum of the BK-24 system (Hungarian People's Republic).

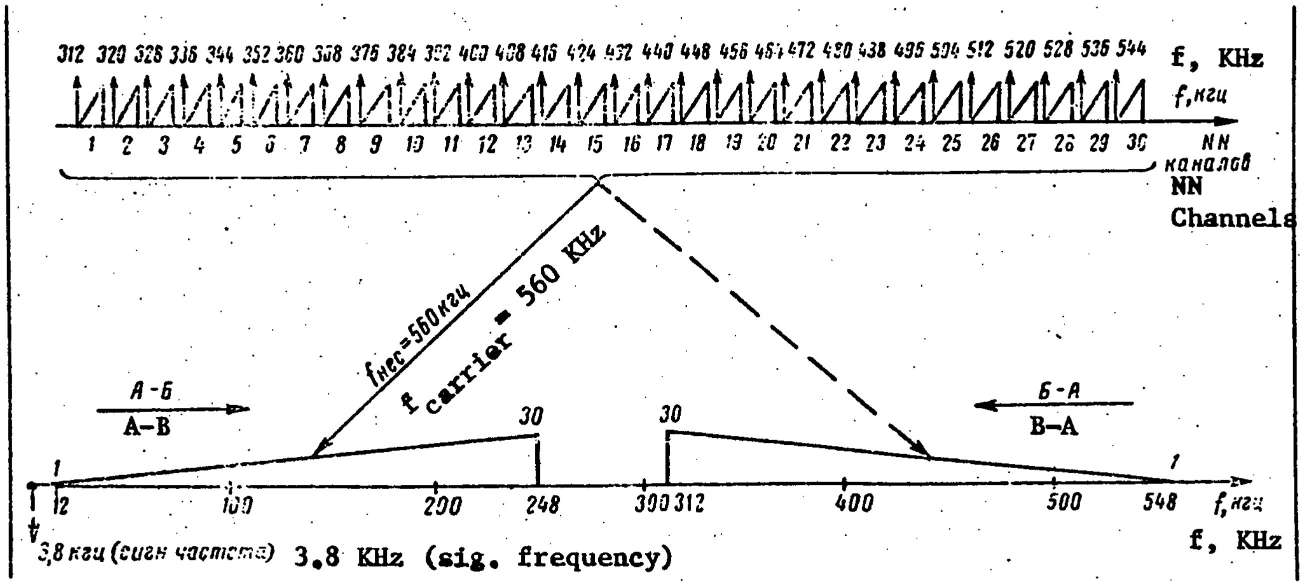


Figure 8. The generation of the line frequency spectrum of the KRR system.

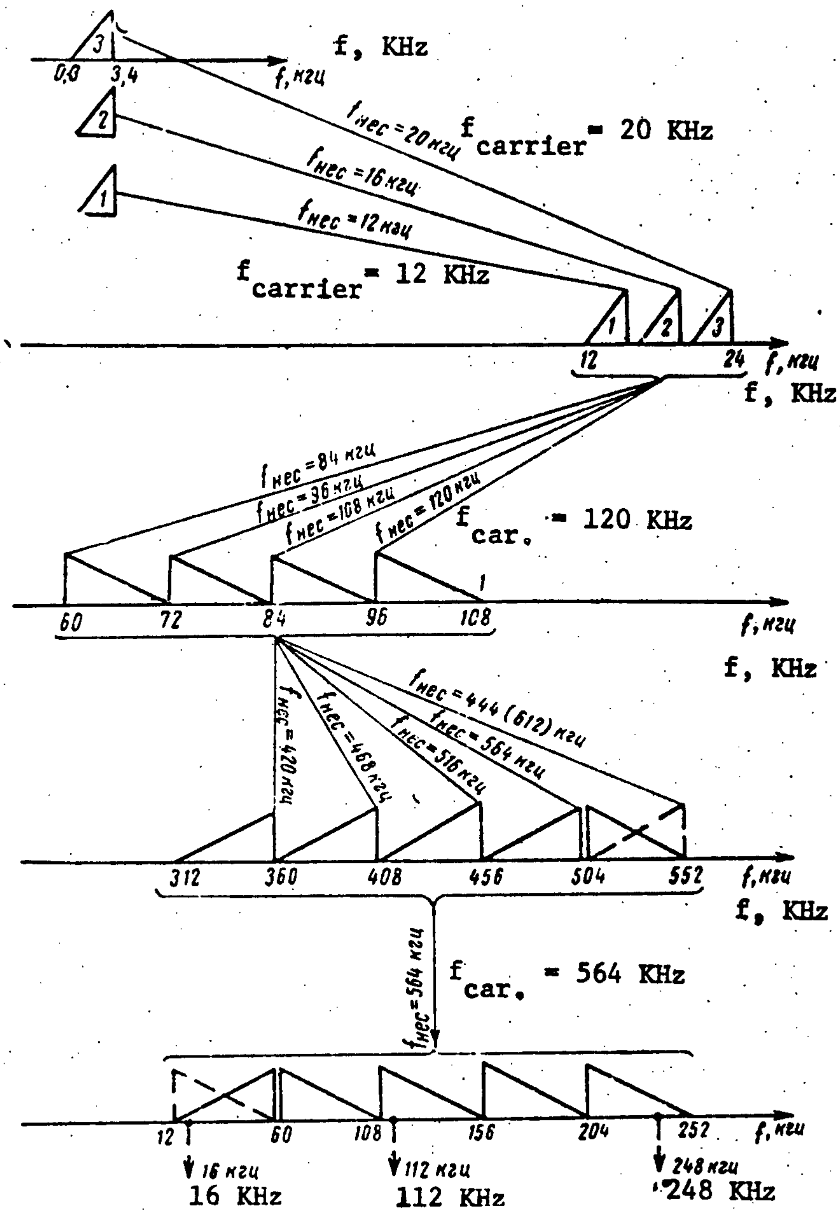


Figure 9. The generation of the line frequency spectrum of the V-60-S (V-60-E) system (German Democratic Republic).

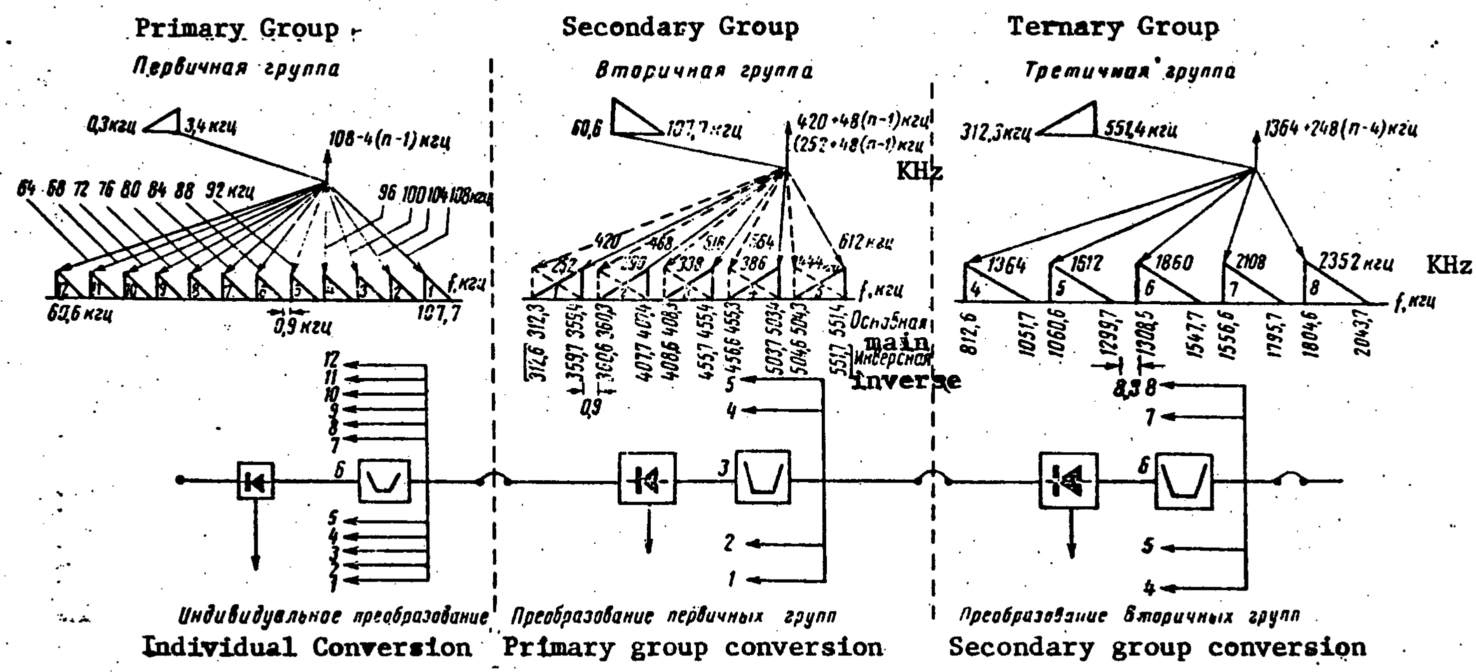


Figure 10. The generation of the main groups and their frequency spectra.

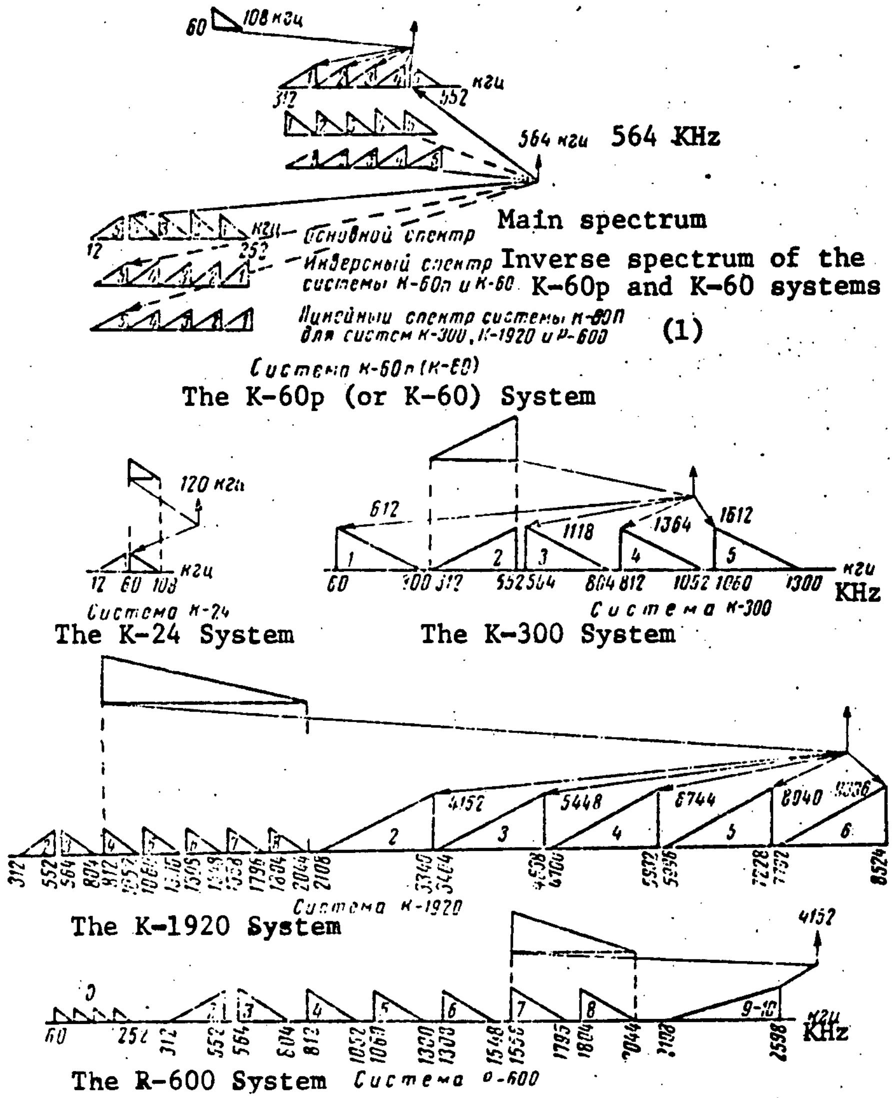


Figure 11. The generation of the line frequency spectra for the K-24, K-60, K-60p, K-300, K-1920 and R-600 systems.

Key: 1) The line spectrum of the K-60P system for the K-300, K-1920 and R-600 systems.

SECTION 1.

Input, Test and Switching Equipment

1.1. The Input Bay, VS

Figures 1.1.1. - 1.1.3.

Purpose: Intended for the connection, switching and operational servicing of open wire circuits.

Capacity: Designed for the connection of 20 physical circuits to the center tap of the line transformer of each circuit.

Equipment Complement:

4 sets for connecting circuits of nonferrous metals, multiplexed up to 150 KHz;
16 sets for connecting physical circuits, multiplexed up to 60 KHz (or unmultiplexed ones);
20 sets of service jacks;
20 sets for connecting Picard telegraph channels;
8 transfer circuit sets;
2 transfer circuit sets for telegraph communications;
5 sets of local battery and municipal telephone exchange service lines;
6 sets of intra-exchange service lines;
4 sets of lineman's service lines;
2 two-wire PVU [intercom-callup units];
2 crosstalk measurement units;
Fuse test and line test board;
Manual magneto ringer;
Clock;
Dial.

Note: Places are provided in the bay for the mounting of: two cable boxes with a capacity of 20 x 2 each; eight bleeder coils, and two to four cable couplings.

Current Consumption: 1.0 amps at 24 volts. In determining the current consumption, the conventional assumption is the operation of all power supply circuits for 4 hours out of a 24 hour day.

Construction: The rack is built on a frame of steel channels filled with panels and blocks on both sides. The height of the table from the floor is 770 mm with a 500 mm extension out from the rack. The rack dimensions are 2,500 x 526 x 745 mm, taking the protruding parts into account.

Weight: 263 kg.

Cost 694 rubles.

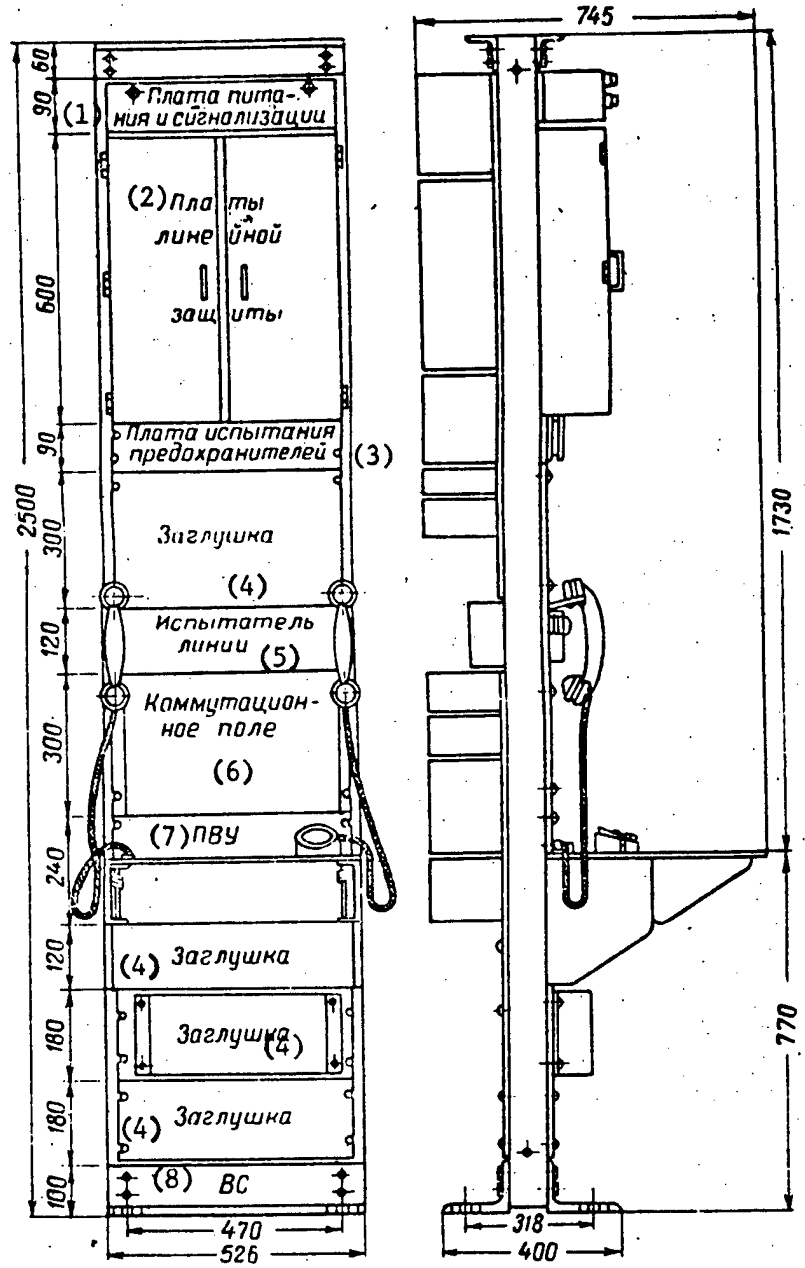


Figure 1.1.1. The equipment layout in the VS input rack.

Key: 1. Power supply and signaling panel;
2. Line protection panels;
3. Fuse test panel;
4. Blank panel;
5. Line tester;
6. Jackfield;
7. PVU [intercom-callup unit];
8. VS [input rack].

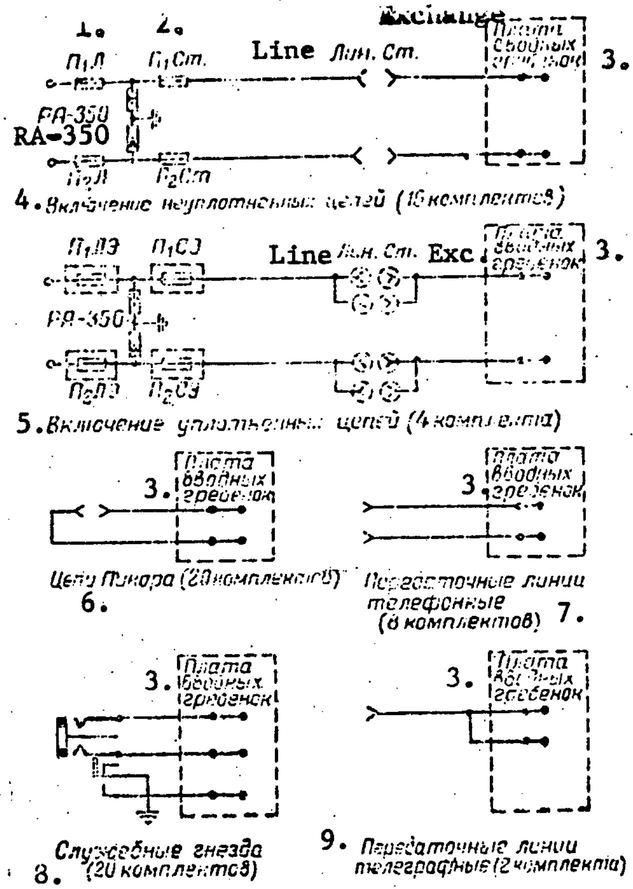


Figure 1.1.2. The connection of the circuits and sets in the VS [input rack].

Key: 1. P_1L [line fuse 1];
2. P_1St [exchange fuse 1];
3. Panel of terminal blocks;
4. The connection of unmultiplexed circuits (16 sets);
5. The connection of multiplexed circuits (4 sets);
6. Picard circuits (20 sets);
7. Transfer telephone line circuits (8 sets);
8. Service jacks (20 sets);
9. Transfer telegraph circuits (2 sets).

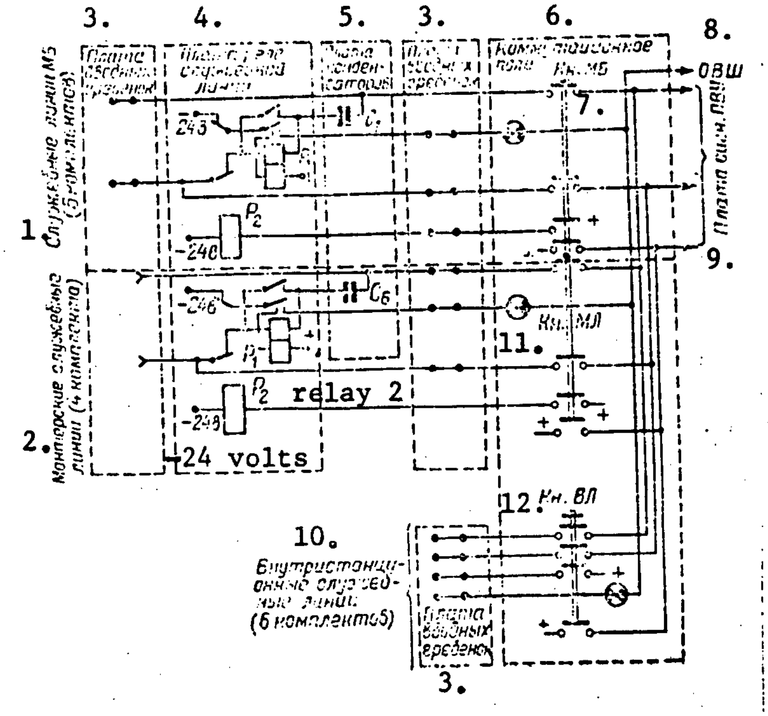


Figure 1.1.3. The connection of service line sets in the VS [input rack].

Key: 1. Local battery service lines (5 sets);
2. Lineman's service lines (4 sets);
3. Panel of input terminal blocks;
4. Panel of service line relays;
5. Capacitor panel;
6. Jackfield;
7. Kn. MB [local battery pushbutton];
8. OVSh [expansion unknown];
9. Intercom-callup unit signaling panel;
10. Intra-exchange service lines (6 sets);
11. ML [?local line?] pushbutton key;
12. VL [?internal line?] pushbutton key.

1.2. The Input-Test Rack, VIS

Figures 1.2.1. - 1.2.3.

Purpose: Intended for the connection, switching and operational servicing of open wire circuits, as well as commununications channels formed on these circuits by any HF systems up to 150 KHz.

Capacity: Designed for connecting 20 physical circuits, and of them: 4 circuits of nonferrous metals and 16 steel circuits, multiplexed up to 60 KHz, or unmultiplexed.

Equipment Complement:

4 sets for connecting circuits of nonferrous metals, multiplexed up to 150 KHz;
16 sets for connecting physical circuits, multiplexed up to 60 KHz (or unmultiplexed ones);
40 sets for connecting telephone channels, of them: 20 are channels with the capability of DGTS [duplex conference call] transmission;
16 sets for connecting Picard telegraph channels;
4 sets for connecting Picard telegraph channels for circuits of nonferrous metals, multiplexed up to 150 KHz;
10 transfer circuit sets;
6 sets for local battery and municipal telephone exchange service lines;
2 sets of central battery service lines;
2 sets of lineman's service lines;
A neper meter;
A crosstalk test unit (PIUS);
A fuse test and line test panel;
A relay panel;
A panel with capacitors;
A panel of fuses and dischargers;
Power supply and signaling panel;
2 PVU's [intercom-callup units] sets (primary and standby);
Jackfield;
Panel with clock;
16 transformers (600:1,400);
3 sets for broadcast transmit channels;
4 sets for two-wire through-working;
2 protection [fuse] boards;

Note: Provisions are made for mounting spaces in the rack for the following: two cable boxes with a capacity of 20 x 2 each, eight bleeder coils, four cable couplings.

Current Consumption: 1.0 amps at 24 volts, and 0.015 amps at 220 volts. When determining the current consumption, the conventional assumption is that all power supply circuits operate for 10 hours out of a 24 hour day.

Construction: The rack is designed around a frame of steel channels with panels filling both sides. The height of the desk from the floor is 770 mm, and it extends 495 mm from the rack. The front part of the desk swings out. The rack dimensions are 2,500 x 526 x 740 mm, taking into account the protruding parts.

Weight: 260 kg.

Cost: 792 rubles.

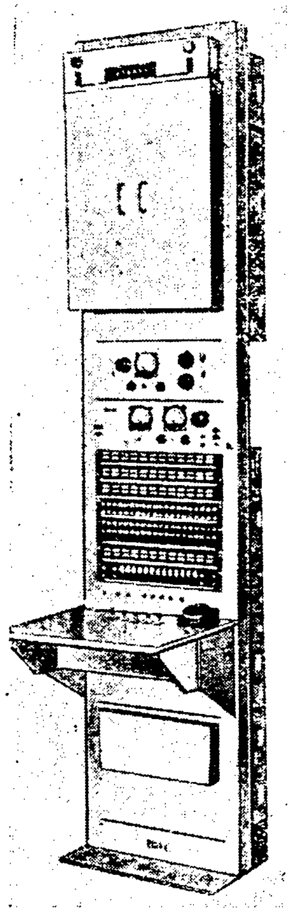


Figure 1.2.1. External view of the VIS input-test rack.

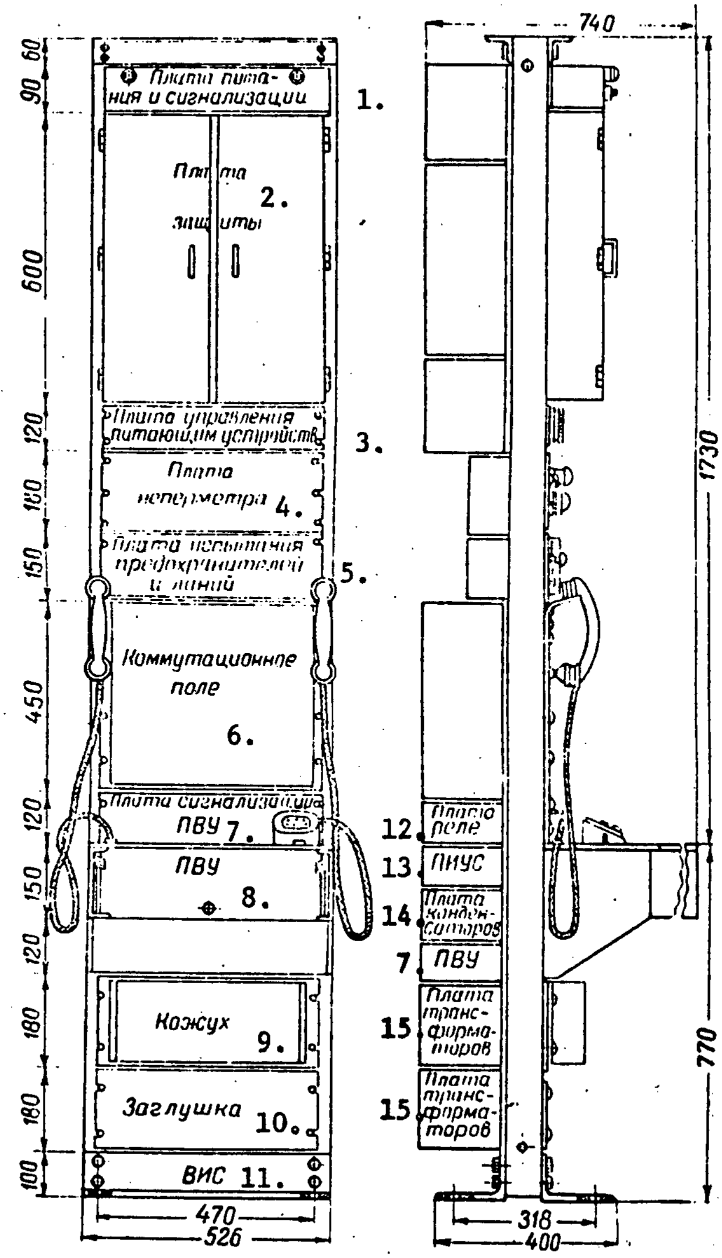


Figure 1.2.2. The equipment layout in the VIS input-test rack.

[Key to Figure 1.2.2]:

1. Power supply and signaling panel;
2. Protection panel;
3. Power supply unit control panel;
4. Neper meter panel;
5. Fuse and line test panel;
6. Jackfield;
7. Intercom-callup unit signaling panel;
8. Intercom-callup unit;
9. Housing;
10. Blank panel;
11. VIS [input-test rack];
12. Relay panel;
13. PIUS [crosstalk test unit];
14. Capacitor panel;
15. Transformer panel.

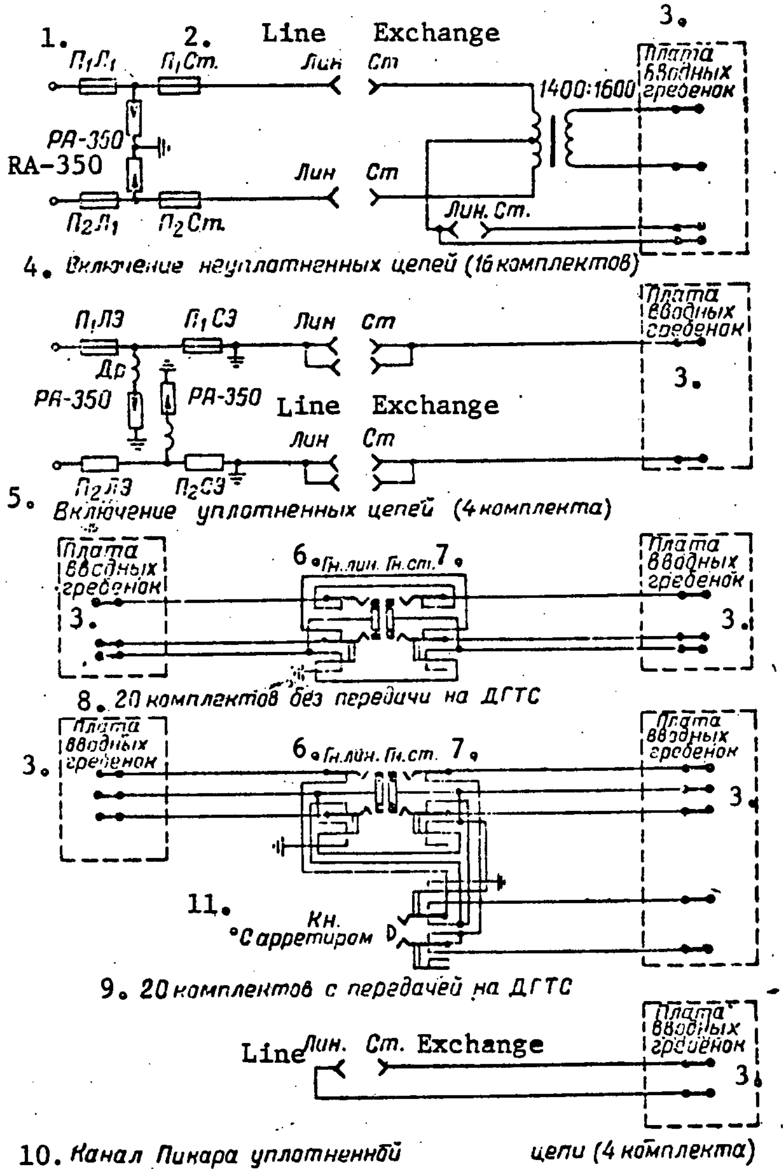


Figure 1.2.3. The connection of circuits and sets in an input-test rack.

Key: 1. P_1L_1 [line 1 fuse 1];
2. P_1St [exchange fuse 1];
3. Panel of input terminal boards;
4. The connection of nonmultiplexed circuits (16 sets);
5. The connection of multiplexed circuits (4 sets);
6. Line jack;
7. Exchange jack;
8. 20 sets without DGTS [duplex conference call] transmission;
9. 20 sets with DGTS;
10. Multiplexed circuit Picard channel (four sets);
11. Key with detente.

1.3. The VIS-4 Input-Test Rack (Taken out of Production)

Figures 1.3.1 - 1.3.2.

Purpose: Intended for the connection and switching of open wire circuits and the high frequency cahnnels formed on them. It is installed at rural communications distributing frames.

Capacity: Designed for connecting 10 open wire circuits, and of them: 4 are of nonferrous metals, multiplexed up to 30 KHz, and 6 are steel, unmultiplexed (with the capability of expansion up to 12).

Equipment Complement:

4 sets for connecting circuits of nonferrous metals, multiplexed up to 30 KHz;
6 sets for connecting steel circuits, unmultiplexed (with the capability of expansion up to 12);
5 sets for connecting Picard telegraph channels;
5 sets for connecting voice frequency (TCh) channels through a transformer;
6 sets for connecting voice frequency channels without a transformer;
4 junction line sets;
2 service line complexes;
Crosstalk measurement unit;
Intercom-callup unit;
Line tester;
Dial..

Current Consumption: 0.25 amps at 24 volts. In determining the current consumption, it is conventionally assumed that all power supply circuits operate for 10 hours out of a 24 hour day.

Note: A BAS-80 battery is required for powering the test line.

Construction: A rack with boards filling one side. The rack dimensions are 2,000 x 530 x 150 mm.

Weight: 110 kg.

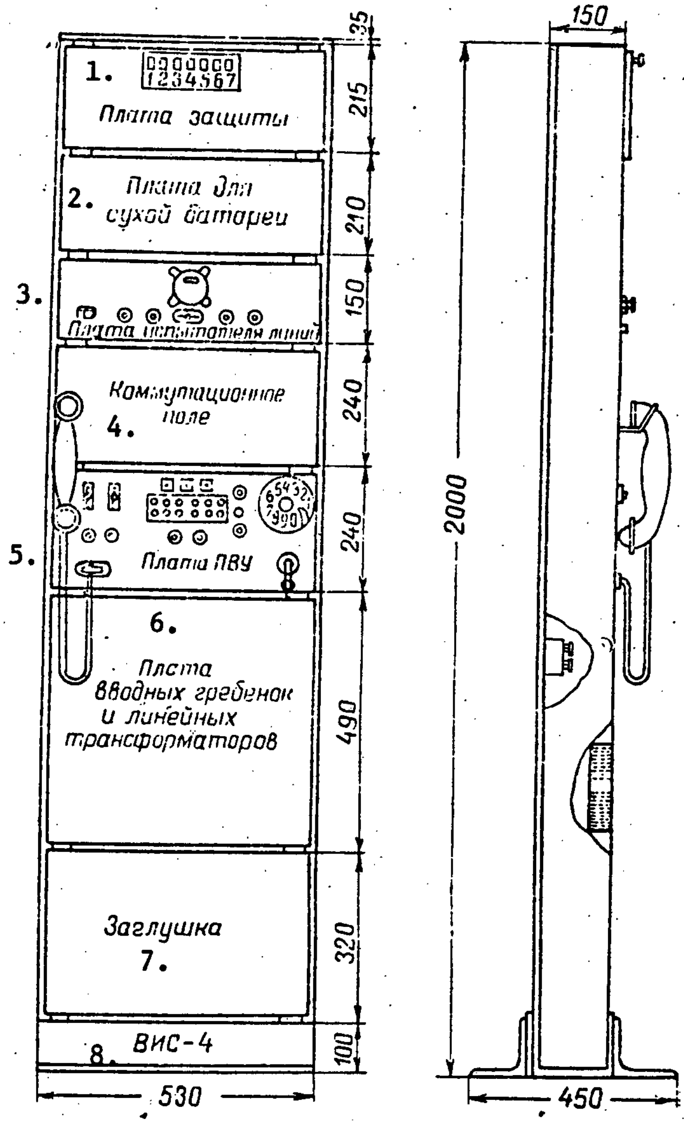


Figure 1.3.1. The equipment layout in the VIS-4 input-test rack.

Key: 1. Protection panel;
2. Panel for the dry battery;
3. Line tester panel;
4. Jackfield;
5. Intercom-callup unit panel;
6. Panel of input terminal blocks and line transformers;
7. Blank panel;
8. VIS-4.

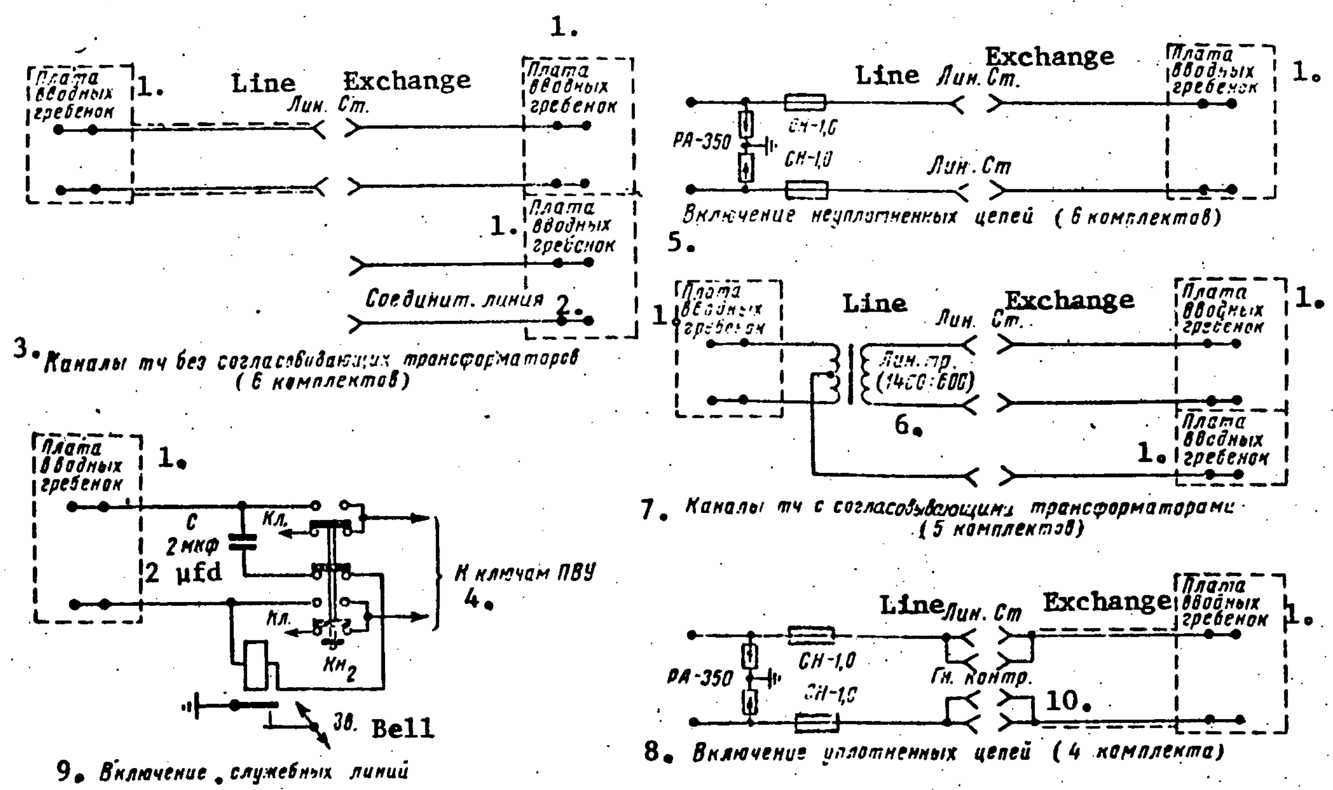


Figure 1.3.2. The connection of the sets in the VIS-4.

Key:
1. Panel of input terminal blocks;
2. Junction line;
3. Voice frequency channels without matching transformers (6 sets);
4. To the intercom-callup unit keys;
5. The connection of unmultiplexed circuits (6 sets);
6. Line transformer (1,400:600);
7. Voice frequency chanels with matching transformers (6 sets);
8. The connection of multiplexed circuits (4 sets);
9. The connection of service lines;
10. Monitor jack.

1.4. The IS Test Rack (Taken out of Production)

Figures 1.4.1., 1.4.2.

Purpose: Intended for performing tests and measurements and substituting voice frequency telephone channels, formed on unmultiplexed and multiplexed circuits.

Capacity: Designed for connecting 20 voice frequency channels of multiplexed circuits and 20 voice frequency channels of unmultiplexed circuits.

Equipment Complement:

20 sets of multiplexed circuit voice frequency channels;

20 sets of unmultiplexed circuit channels;

20 four-wire through-working sets;

5 two-wire through-working sets;

20 sets for duplex conference call channel transmission;

5 sets for broadcast channel transmission;

20 transfer circuit sets;

3 local battery service line sets;

2 central battery service line sets;

2 intercom-callup unit sets (two- and four-wire ones);

5 intra-exchange service line sets;

20 transformers (1,400:600);

Neper meter;

Loudspeaker;

Dial;

Clock.

Current Consumption: 1.0 amps at 24 volts and 0.015 amps at 220 volts. In determining the current consumption, the conventional assumption is that all power supply circuits operate for 10 hours out of a 24 hour day.

Construction: The rack is built around a frame of steel channels with panels filling both sides. The height of the desk from the floor is 770 mm, and extends 500 mm out from the rack. The rack dimensions are 2,500 x 526 x 745 mm, taking the protruding parts into account.

Weight: 300 kg.

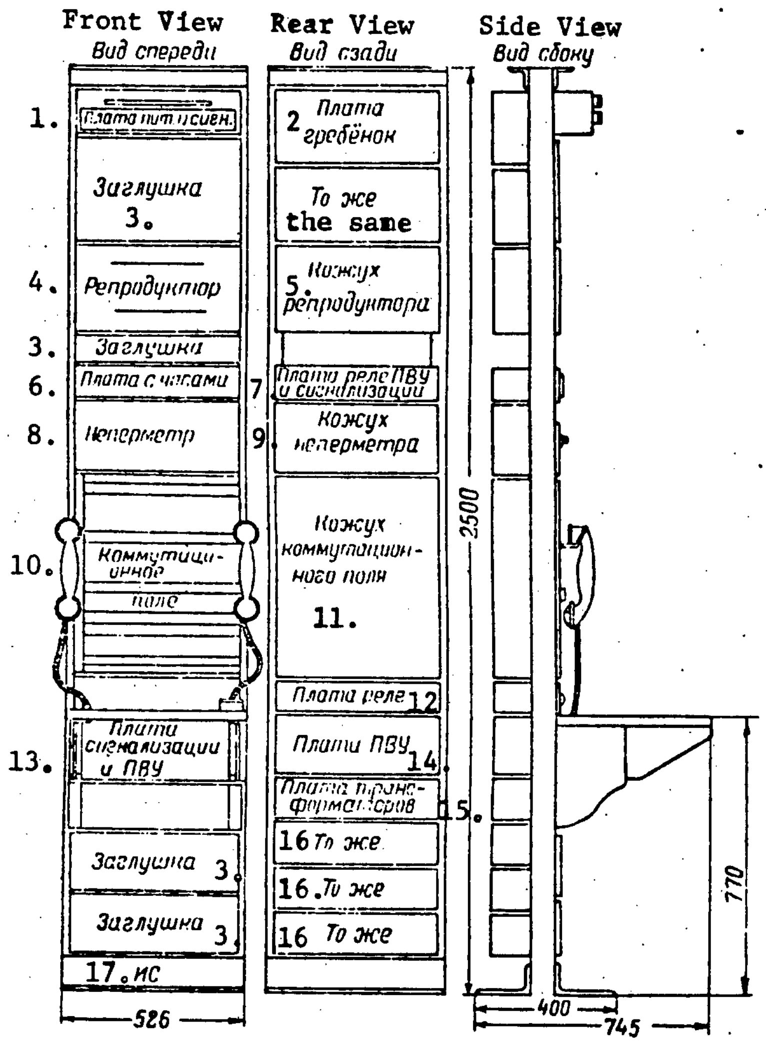


Figure 1.4.1. The equipment layout in the IS test rack.

Key: 1. Power supply and signaling panel;
2. Panel of terminal blocks;
3. Blank panel;
4. Loudspeaker;
5. Loundspeaker housing;
6. Panel with clock;
7. Panel of intercom-callup unit and signaling relays;
8. Neper meter;
9. Neper meter housing;
10. Jackfield;
11. Housing for the jackfield;
12. Relay panel;
13. Signaling and intercom-callup unit panel;
14. Intercom-callup unit panel;
15. Panel of transformers;
16. The same;
17. IS [test rack].

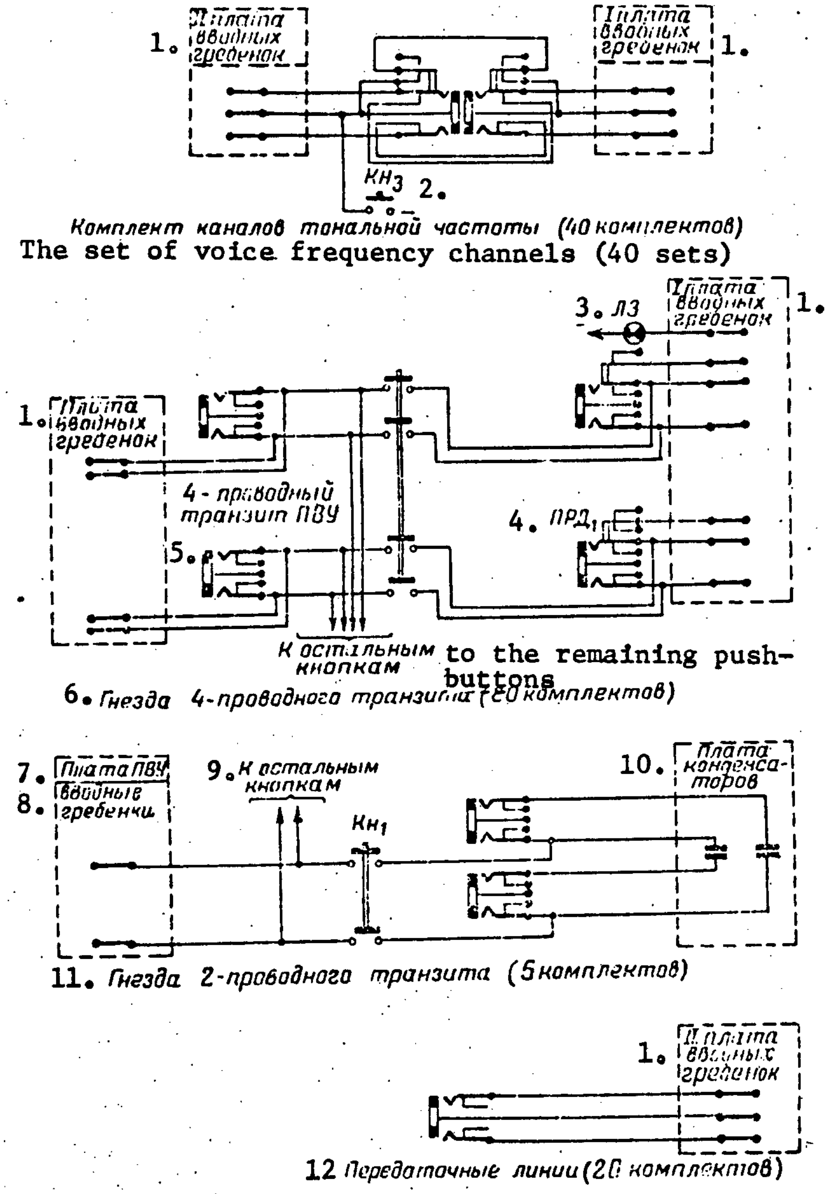


Figure 1.4.2. The schematic of the connection of the various sets in the test rack.

Key:
1. Panel of input terminal blocks;
2. Pushbutton key 3;
3. LZ [?busy light?];
4. PRD_1 [expansion unknown];
5. Four-wire intercom-callup unit through working;
6. Four-wire through-working jacks (20 sets);
7. Intercom-callup unit panel;
8. Input terminal blocks;
9. To the remaining pushbutton keys;
10. Panel of capacitors;
11. Two-wire through-working jacks (5 sets);
12. Transfer circuits (20 sets).

1.5. The IS-2 and IS-4 Type Test Racks

Figures 1.5.1 - 1.5.3.

Purpose: They are intended for monitoring and testing two and four-wire voice frequency channels, generated in the LATs [line equipment shop], and employed for manual, semiautomatic and automatic telephone service on cable, open wire and radio relay communications lines.

Housed in the IS-2 rack are the test instruments and controls. The IS-4 rack is a switching rack and is used in conjunction with the IS-2 rack. In this case, the IS-4 rack can be employed for switching the channels of non-jackcord type long distance telephone offices.

Equipment Complement:

The IS-2 Rack:

2 intercom-callup units (four- and two-wire ones);
2 blocks for checking semiautomatic channels;
2 phantom lines;
2 voice frequency dialing receivers;
3 blocks of transmit amplifiers and a transition unit [hybrid terminal station];
3 selective call receiver blocks;
Trunk service communications block;
Voice frequency ringing generator at 24 fixed frequencies in a range of 420 - 3,180 Hz (every 120 Hz).
6 channel partitioning blocks;
3 plan through-working blocks;
2 control and receive blocks;
Relay block;
A 500/20 - 1000/20 GTV [voice frequency ringing generator] block;
A 2100 (1600) GTV block;
Neper meter;
UNP-60 psophometric noise meter;
Amplifier;
20 transfer lines;
Protection and signaling block.

The IS-4 Rack:

120 sets of four-wire jacks. Each set consists of line and exchange receive and transmit jacks for a four-wire channel, a holding key, a disconnect key and transmit and receive jacks for the four-wire input to the IKTN [outgoing voice frequency dialing complex] of a long distance exchange of the non-jackcord type;
Intercom-callup units (two- and four-wire ones) with a dial;
Control and receive block;
Test instrument for checking the IKTN complexes.

Electrical Power Supply:

Voltages:

Relay and signaling circuits	24 volts ± 10%
Amplifier and generator equipment (IS-2)	21.2 volts ± 3%
Test instrument supply circuits	60 volts, -2 volts, +4 volts;

Current Consumption for the IS-2:

Relay power supply	4 amperes
Signaling power supply	1.0 amperes
Amplifier and generator equipment	0.5 amperes

Construction:

The IS-2 and IS-4 racks take the form of a light steel frame, consisting of an upper, lower and two side frames, manfactured from п-section steel. The rack dimensions are 2,600 x 650 x 700 mm. A small desk with a slide-out drawer is installed at a height of 700 mm from the floor.

Installed in the frame of the IS-2 rack are bottom plates, on which blocks are placed having grooves cut in the front or rear. Located in the top part of the rack are the input terminals and the panel of fuses for the power supply input. Positioned on the sloping panel are the control and receive blocks, and the intercom-callup unit. The side and rear walls are covered by plates.

Installed in the IS-4 rack are blocks with grooves cut in the rear. Located on the sloping panel are the control and receive block, the intercom-callup unit and the instrument for checking the semiautomatic complexes. For convenience in the wiring and servicing, there are doors on the rear wall. The rack is supplied without the wiring.

Weight:

IS-2	450 kg
IS-4	300 kg

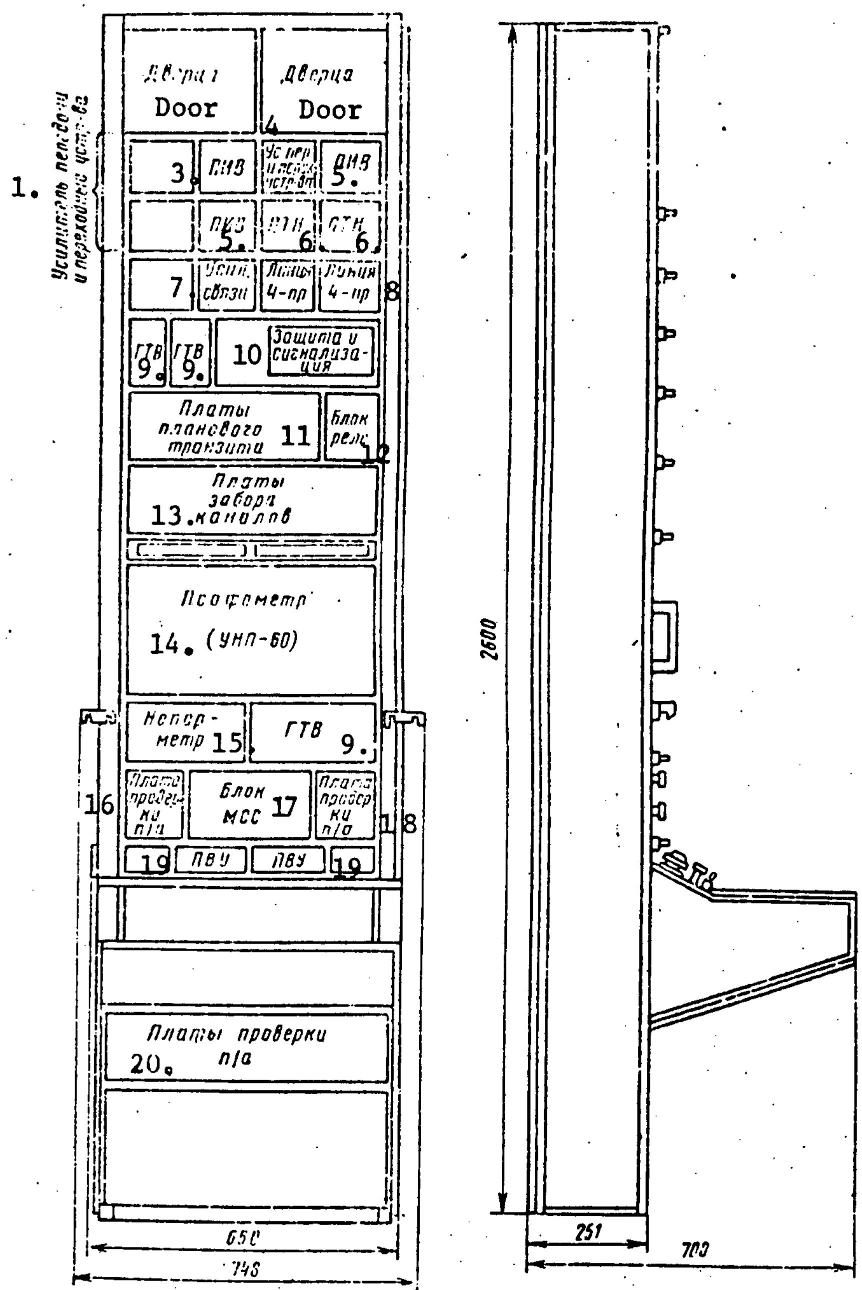


Figure 1.5.1. The layout of the blocks in the IS-2 test rack.

Key: 1. Transmit amplifier and transition units;
2. Doors;
3. PIV [selective call receiver];
4. Transmit amplifier and transition units;
5. PIV;
6. PTN [voice frequency dial receiver];

[Key to Figure 1.5.1. Continued]:

7. Communications amplifier;
8. Four-wire line;
9. GTV [voice frequency ringing generator];
10. Protection and signaling;
11. Plan through-working boards;
12. Relay block;
13. Channel partitioning boards;
14. Psophometric noise meter (UNP-60);
15. Neper meter;
16. Semiautomatic check panel;
17. MSS [trunk service communications] block;
18. Semiautomatic check panel;
19. PVU [intercom-callup unit];
20. Semiautomatic [communications] check panels.

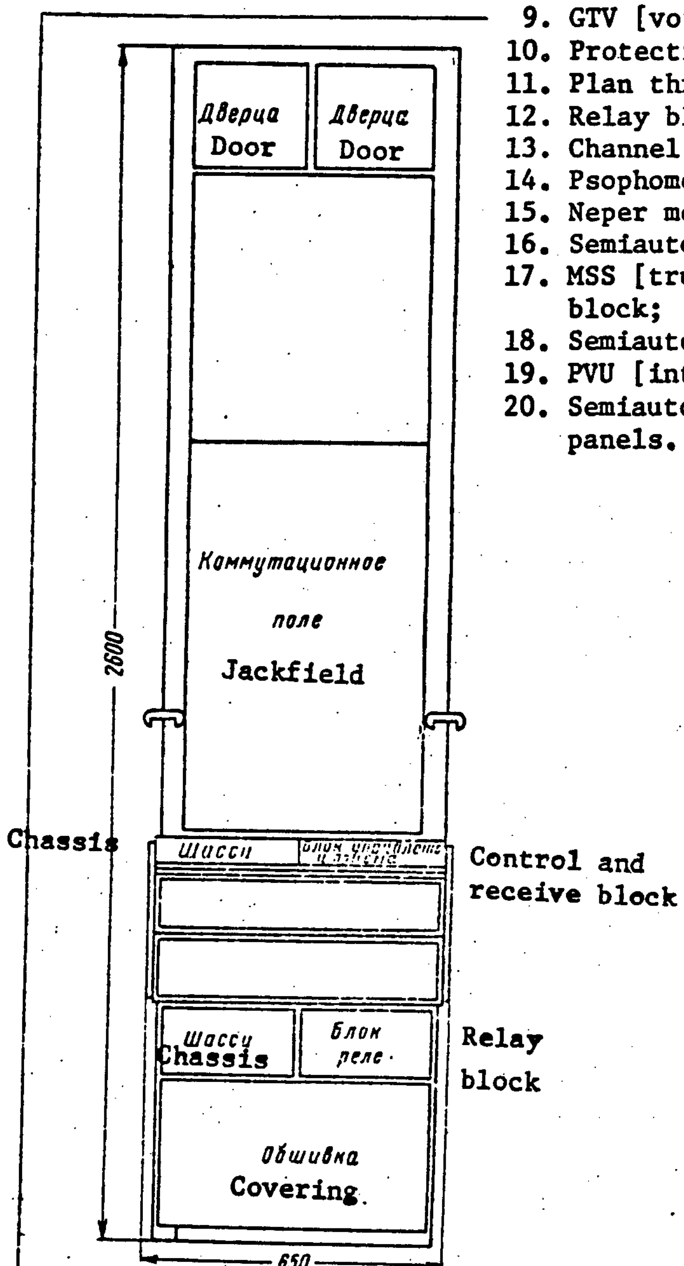


Figure 1.5.2. The equipment layout in the IS-4 test rack.

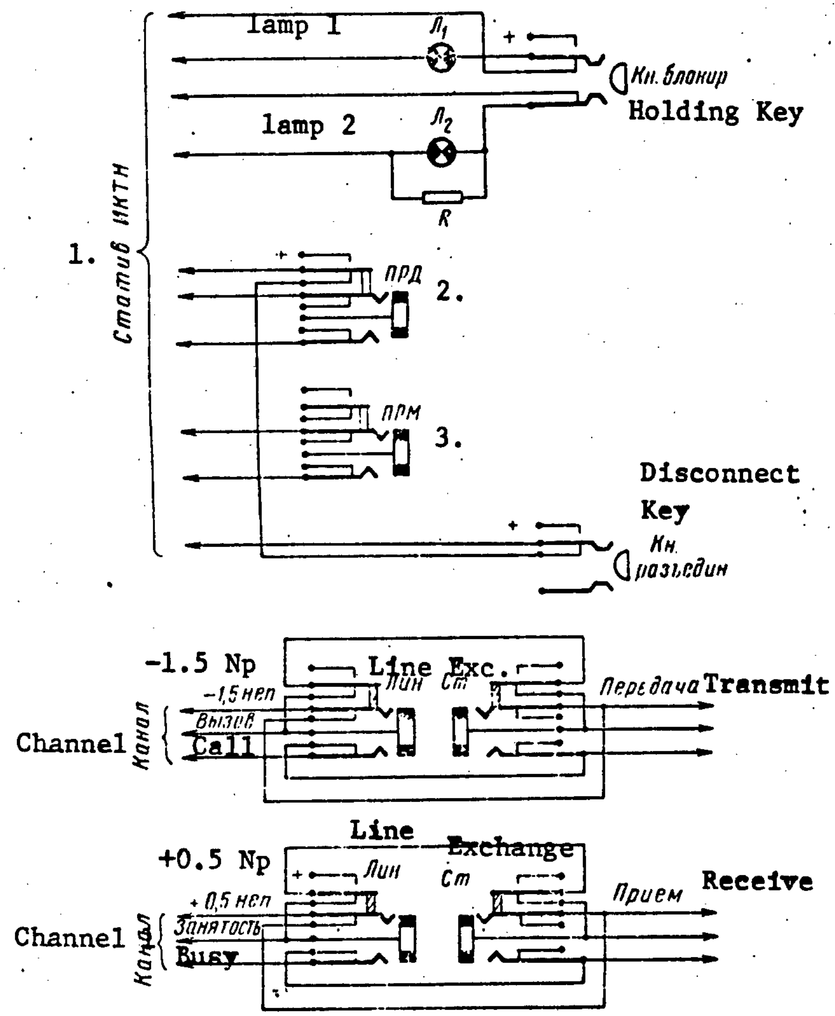


Figure 1.5.3. Schematic of a set of the IS-4 jackfield.

Key: 1. Outgoing voice frequency dialing complex;
2. PRD [expansion unknown];
3. PRM [expansion unknown].

1.6. The IST-M Test--Through-working Rack

Figures 1.6.1 - 1.6.3.

Purpose: It is intended for connecting and servicing two- and four-wire voice frequency channels, as well as for making two- and four-wire through working voice frequency connections and channel transmission to other line equipment shop services.

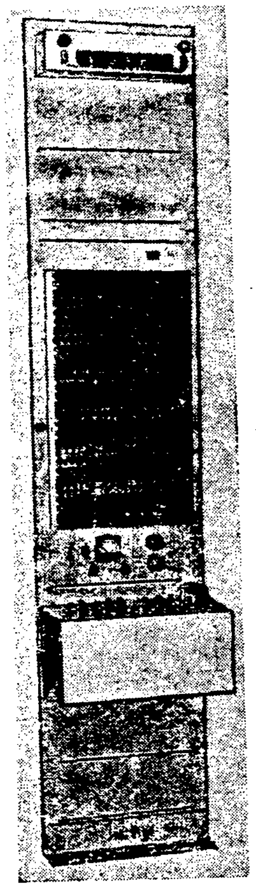


Figure 1.6.1. An external view of the IST-M test--through-working rack.

Capacity: It is designed for connecting 120 sets for voice frequency channels and 20 sets for channel transmission in duplex conference call service.

Equipment Complement:

120 sets, each consisting of two jacks, pushbutton keys and a signal light;
20 pushbutton keys for switching the channels in duplex conference call service;
3 sets of local battery service lines;
2 sets of central battery service lines;
5 sets of intra-exchange service lines;
Neper meter (generator and level indicator);
2 intercom-callup units, of which one two- and four-wire;
10 line transformers, 1,400:600 ohms, (space is set aside for the installation of 10 more units);
Dial;
Clock.

Notes: 1. On special order, a power supply unit can be installed which consists of two rectifiers for powering the rack from the 220 volt AC main;

2. In wiring the 120 sets of jacks, the factory runs additional wires for the capability of rewiring the jacks in place for the purpose of organizing four-wire plan through-working.

Current Consumption: 1.0 amps at 24 volts, and 0.015 amps at 220 volts. In determining the current consumption, it is conventionally assumed that all power supply circuits operate for 15 hours out of a 24 hour day.

Construction: The rack is built on a frame of steel channels with panels filling both sides. The height of the desk from the floor is 770 mm, and it extends 500 mm out from the rack. The rack dimensions are 2,500 x 530 x 745 mm.

Weight: 280 kg;

Cost: 956 rubles.

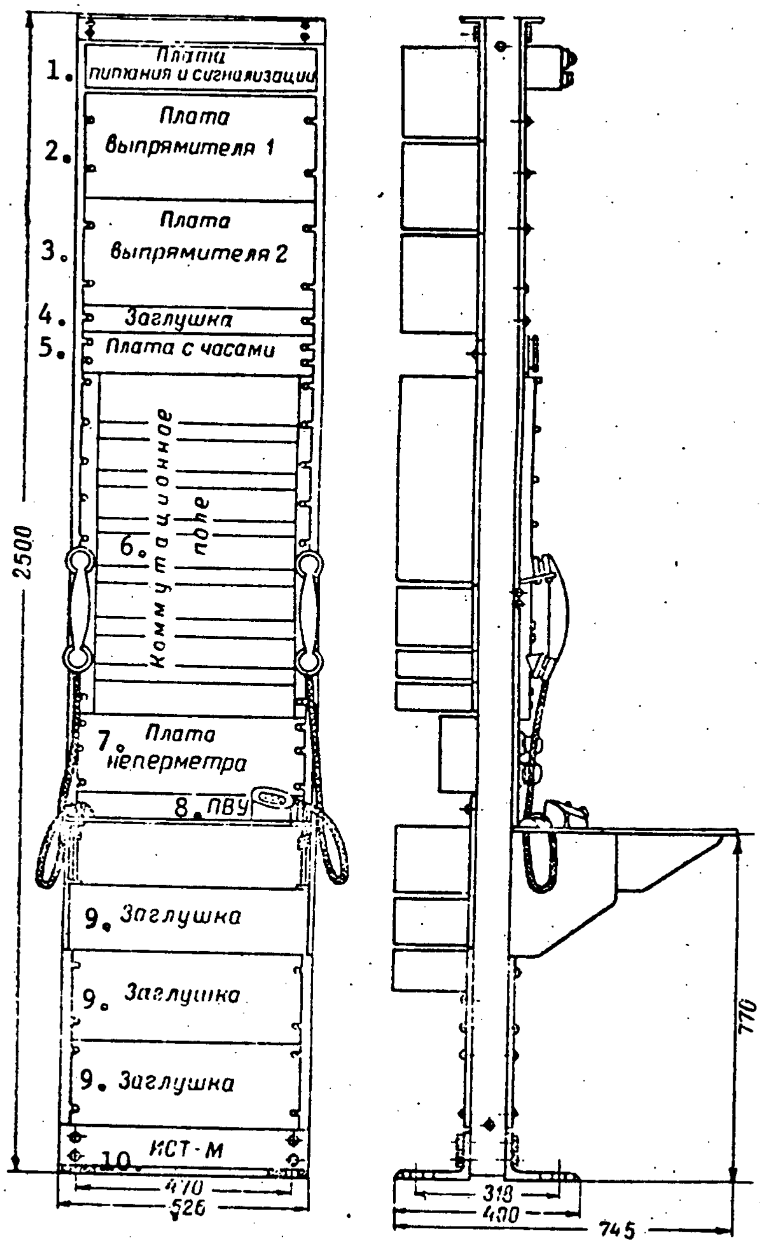


Figure 1.6.2. The equipment layout in the IST-M test—through-working rack.

Key:
1. Power supply and signaling panel;
2. Rectifier 1 panel;
3. Rectifier 2 panel;
4. Blank panel;
5. Panel with clock;
6. Jackfield;
7. Neper meter panel;
8. Intercom-callup unit;
9. Blank panel;
10. IST-M [test—through-working rack].

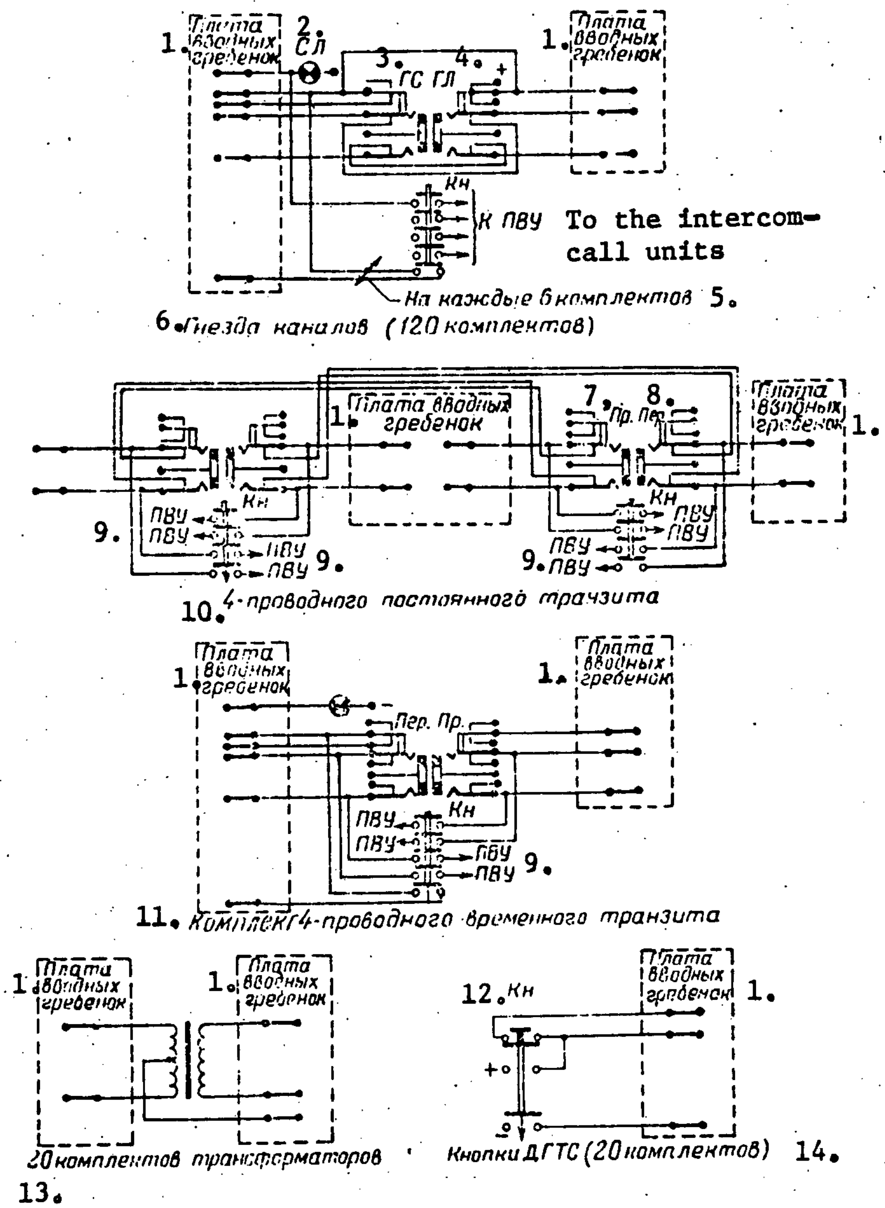


Figure 1.6.3. Schematic for the connection of circuits and sets in the IST-M.

Key:
1. Panel of input terminal blocks;
2. SL [?signal light?];
3. GS [exchange jack];
4. GL [line jack];
5. To each 6 sets;
6. Channel jacks (120 sets);
7. Receive;
8. Transmit;
9. Intercom-callup unit;
10. Four-wire permanent through-working;
11. Four-wire temporary through-working set;
12. Pushbutton key;
13. 20 sets of transformers;
14. DGTS [duplex conference call] keys (20 sets).

1.7. The PSP Intermediate Switching Rack

Figures 1.7.1. - 1.7.7.

Purpose: It is intended for switching the voice frequency channels of line equipment shops of long distance telephone exchanges and communications centers.

Capacity:

The PSP rack is produced in two variants:

-- For 600 6-wire cross-connections without the relay and attenuator pad panels;

-- For 480 6-wire cross-connections with the relay and 0.5, 1.5 and 2.0 neper attenuator pad panels.

Prior to modernization, industry also produced the PSP racks in two variants, but with the following complement:

-- For 600 4-wire cross-connections without the relay and attenuator pad panels;

-- For 480 4-wire cross connections with the relay and 0.3 neper attenuator pad panels.

Given below is the equipment complement for the modernized PSP rack.

Equipment Complement of the Racks:

PSP-0. A rack of 600 6-wire cross-connection fields, on which 30 terminal blocks each of 20 x 6 terminals are located at the exchange and line ends. The terminal blocks are numbered from the top downward, beginning with the left row for the exchange end, and with the right row for the line end.

PSP-2. A rack of 480 6-wire cross-connection fields, on which 24 terminal blocks each of 20 x 6 terminals are located at the exchange and line ends. Located at the exchange end are two relay and attenuator pad panels of the PRU-1 and PRU-2 types (one panel of each type).

PSP-4. A rack of 480 6-wire cross-connection fields, on which 24 terminal blocks each of 20 x 6 terminals are located at the exchange and line ends. Located at the exchange end are four relay and attenuator pad panels of the PRU-1 and PRU-2 types (two panels of each type).

Note: Additionally, there the option of installing a supplemental PU-20 board in the PSP-2 and PSP-4 racks.

Component Complement of the Panels:

PRU-1. 10 type RPN relays, 10 pads of 0.5 nepers each and 10 pads of 2 nepers each.

PRU-2. 10 RPN relays, 10 pads of 1.5 nepers each, and 10 pads of 2 nepers each.

PU-20. 20 pads of 2 nepers each.

All types of panels are supplied by the plant without wiring. On special order, where the location of the board is indicated in the PSP rack (III, IV or V), as well as the free terminal blocks which are proposed for installation (terminal blocks 16, 15 and 14 for the exchange, and terminal blocks 16, 15 and 14 for the line), the plant can supply the panels with cable bundles or prepare cable bundles going to them.

Note: The PRU-1, PRU-2 and PU-20 panels are supplied by the plant as a separate product for their installation in the intermediate switching racks, or other racks of a line equipment shop.

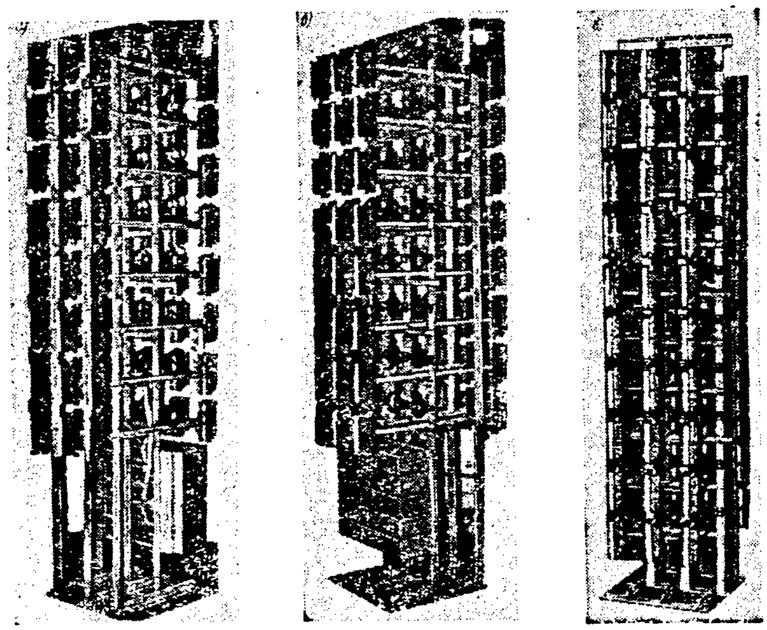
Construction:

PSP. The rack is constructed of angle and bar steel. The dimensions of the rack are 2,500 x 526 x 816 mm.

PRU-1, PRU-2 and PR-20. Swing-out panels on hinges. The dimensions of the panels are 88 x 480 x 180 mm.

Weight and Cost:

Стойка или плата	Rack or Panel	Вес, кг Weight, kg	Цена, руб. Price, rubles
ПСП-0	PSP-0	97,5	161
ПСП-2	PSP-2	100	283
ПСП-4	PSP-4	121	425
ПРУ-1	PRU-1	5,3	71
ПРУ-2	PRU-2	5,3	71
ПУ-20	PU-20	3,3	50



(a) (b) (c)

Figure 1.7.1. Exterior view of the intermediate switching racks:

(a) With relay and PSP-4 attenuator pad boards, view from the line end;
(b) The same, view from the exchange end;
(c) The same, without the boards, relays and PSP-0 attenuator pads.

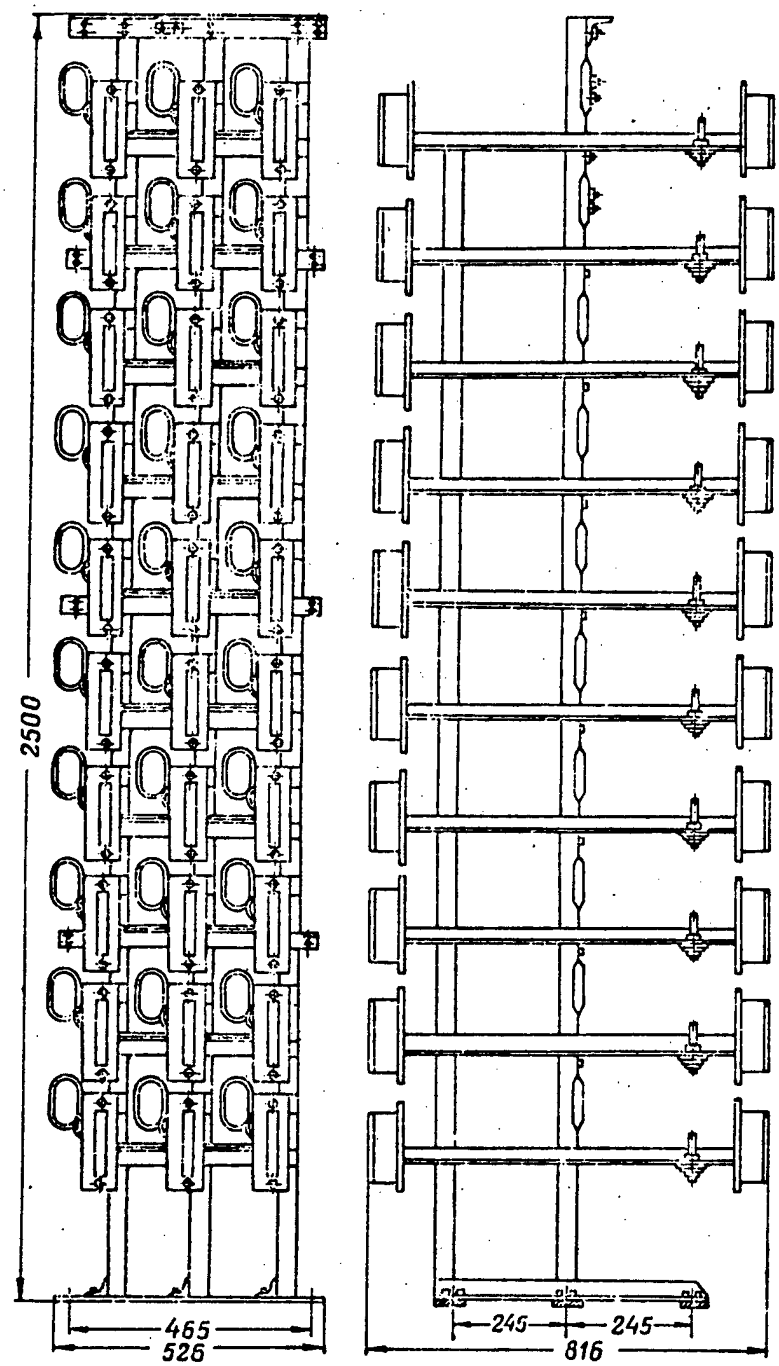


Figure 1.7.2. The layout of the equipment components in the PSP-0 intermediate switching rack.

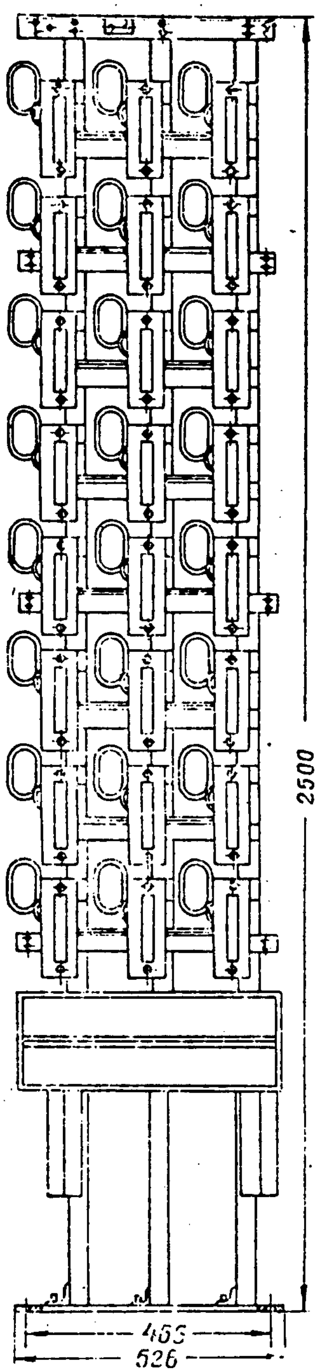


Figure 1.7.3. The layout of the equipment components in the PSP-2 intermediate switching rack.

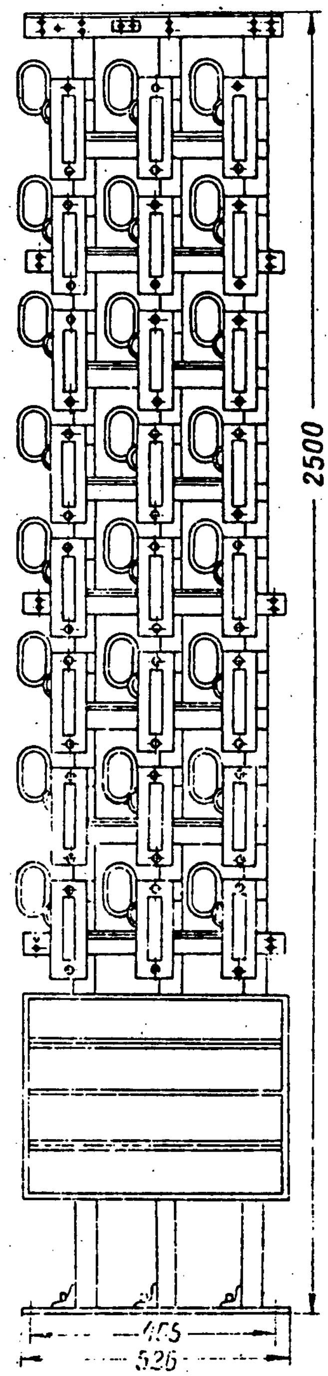


Figure 1.7.4. The layout of the equipment components in the PSP-4 intermediate switching rack.

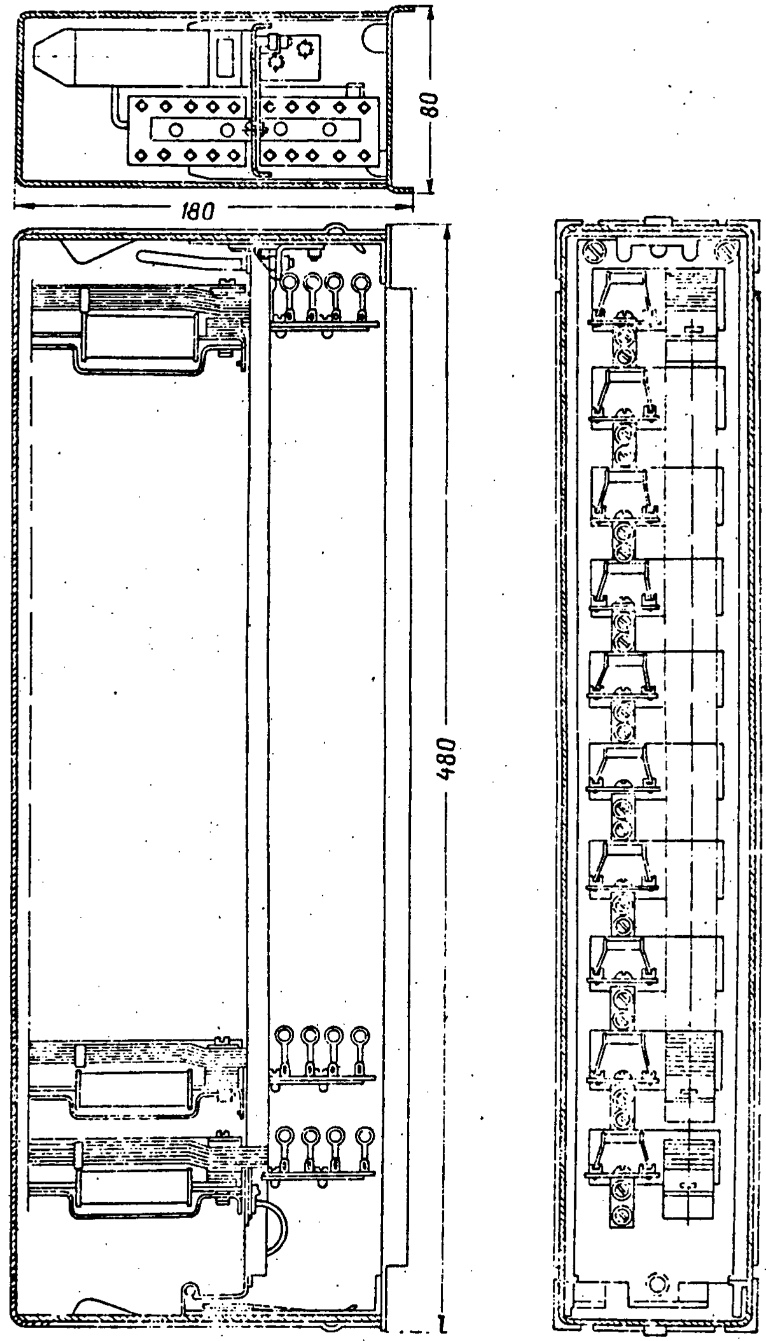


Figure 1.7.5. The layout of the equipment components on the board of relays and 0.5 neper or 1.5 neper pads of the PSP rack.

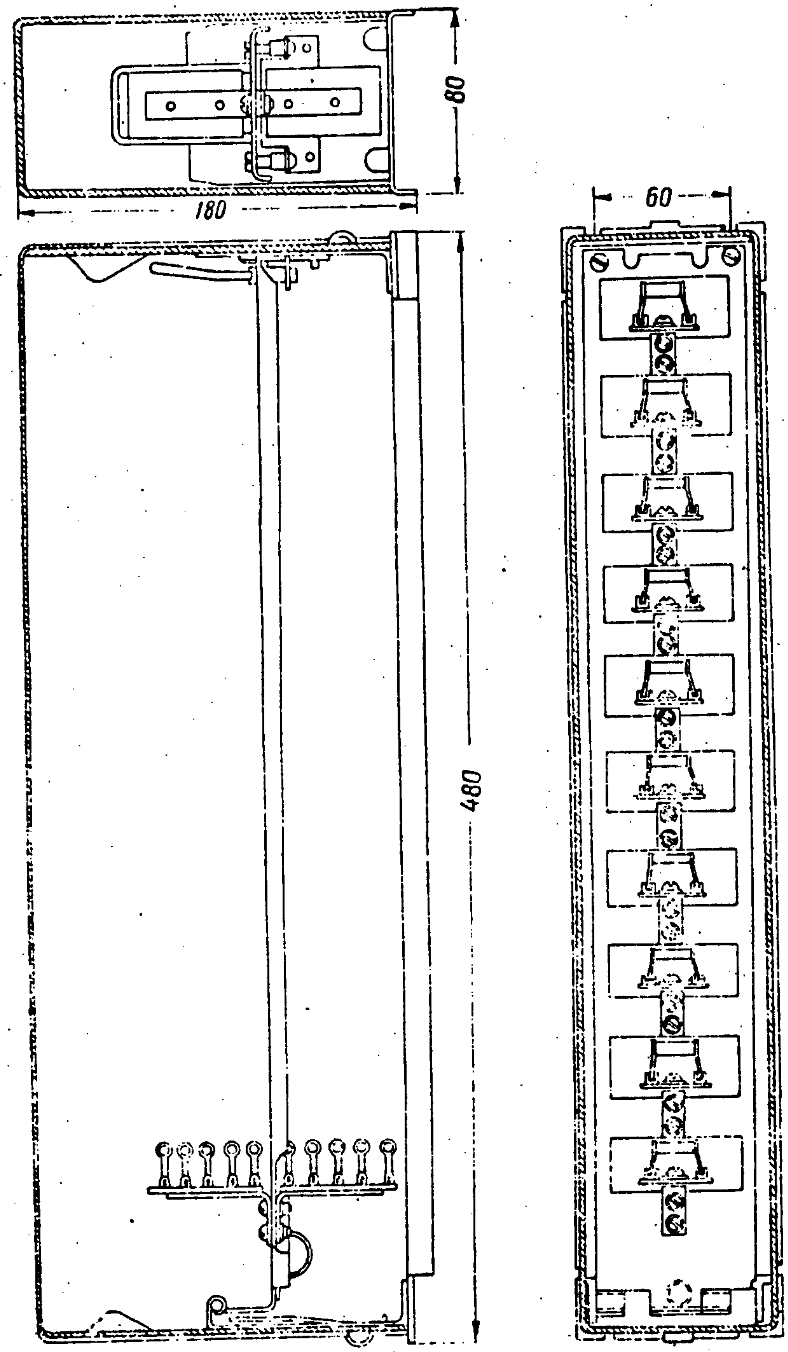
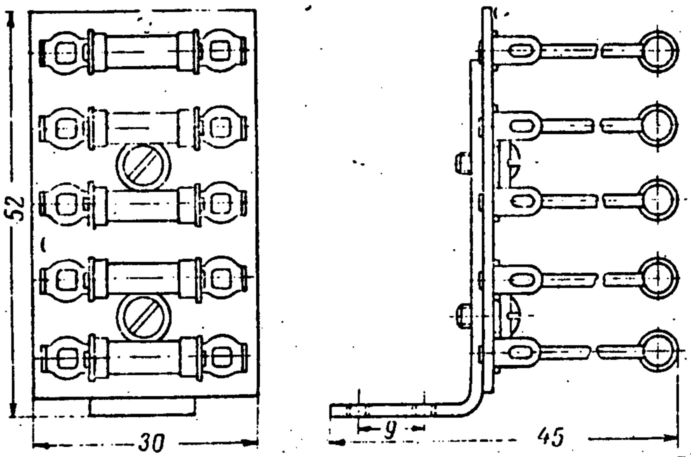
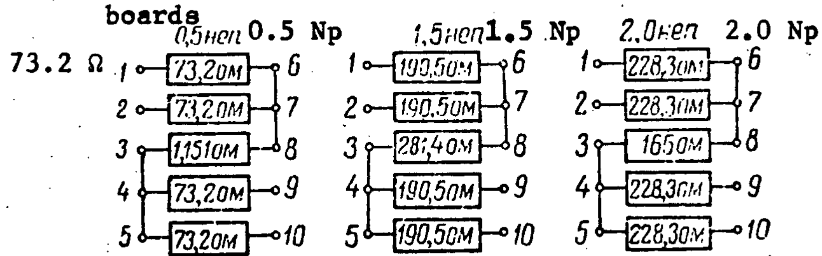


Figure 1.7.6. The layout of the equipment components on the 0.2 neper attenuator pad board of the PSP rack.



Конструкция удлинителей, установленных на платах ПСП

Construction of the pads, mounted on the PSP boards



Монтажная схема удлинителей 0,5неп; 1,5неп, 2,0неп

Figure 1.7.7. The attenuator pads of the boards of the PSP rack.

1.8. The SKP-1 Primary Group Switching Rack

Figures 1.8.1. - 1.8.3.

Purpose: Intended for switching 12-channel groups by means of flexible cords and resoldering. It is installed in a line equipment shop where, as a rule, the long term prospect is for no less than 10 primary groups of the systems.

Capacity: It provides for the capability of simultaneously switching 50 12-channel groups in the transmit direction and 50 12-channel groups in the receive direction. Moreover, 20 junction lines each for each direction (transmit and receive) can be brought into the rack.

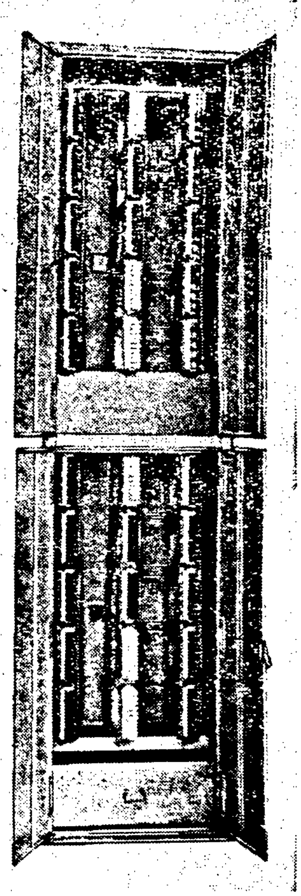


Figure 1.8.1. External view of the SKP-1 primary group switching rack, with the door open.

Equipment Complement:

Located in the upper part of the rack is the transmit route equipment, and in the lower part, the receive route equipment. Installed on the front side of the rack for both routes in rows A and V [C] are 20 shielded shelves of 20 jacks each for switching the 12-channel groups, and in the center row, B, four shielded shelves of the same type, and six shielded shelves (without jacks) for switching the junction lines. Mounted on the back of the rack for both routes in the A, B and C rows are 30 shielded shelves. The shielded shelves of row A are intended for connecting in cables, coming from SPP [primary converter bay] racks, and the shielded shelves of row C are intended for connecting in cables coming from SIP [individual converter bay] racks.

The odd pairs of jacks of the shielded shelves of 20 jacks, A and C, of the front side are connected via the intra-rack wiring to the shielded shelves of row A of the rear of the rack; the even pairs of jacks of the shielded shelves of 20 jacks of rows A and C of the front side are connected by the intra-rack wiring to the shielded shelves of row B of the rear of the rack.

Construction:

The rack is made in the form of a cabinet. The rack dimensions are 2,600 x x 650 x 580 mm. The construction of the cabinet allows for the option of joining two and more racks together.

Weight: 200 kg;

Cost: 2,000 rubles.

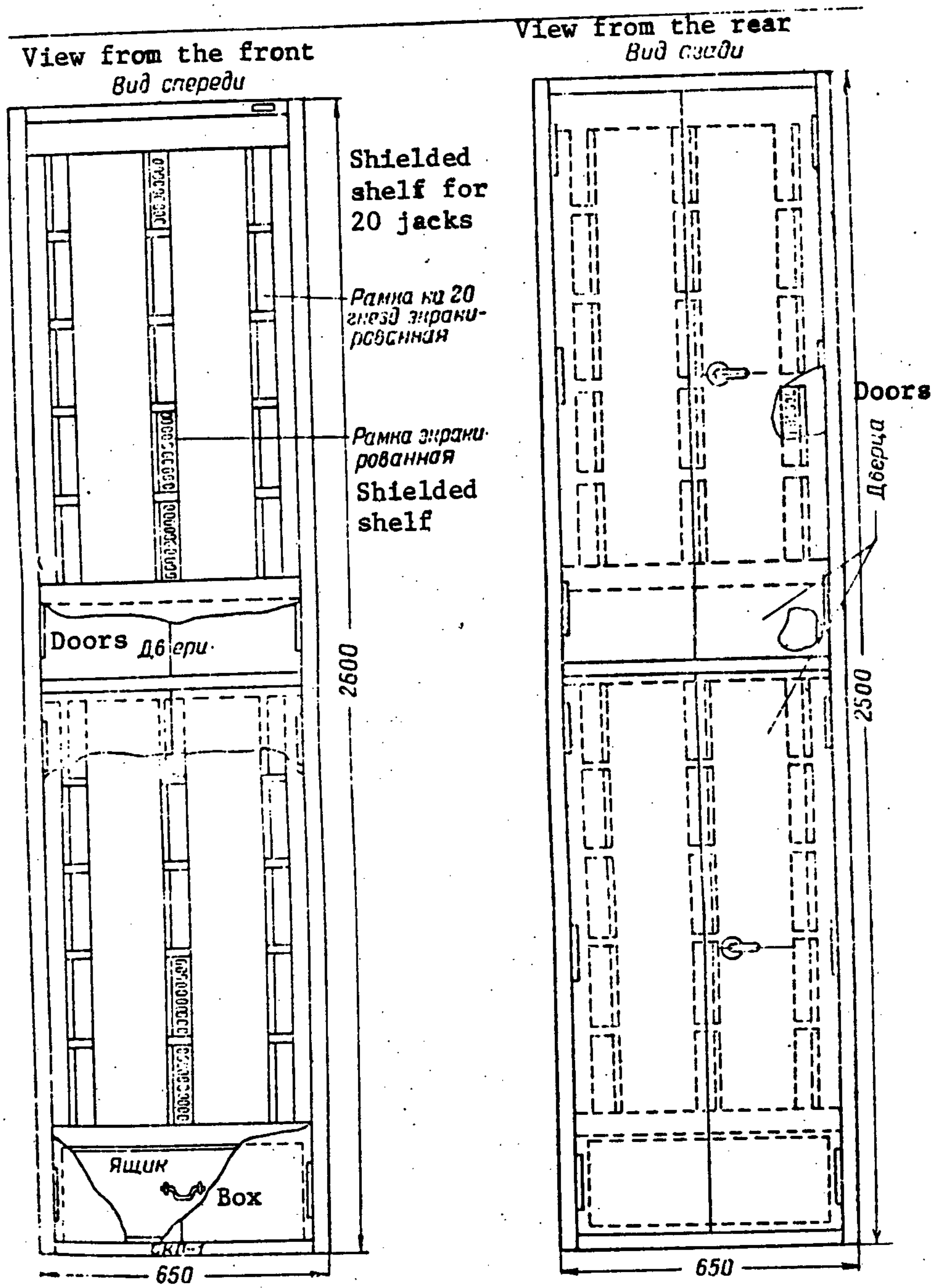


Figure 1.8.2. The placement of the equipment components in the SKP-1 primary group switching rack.

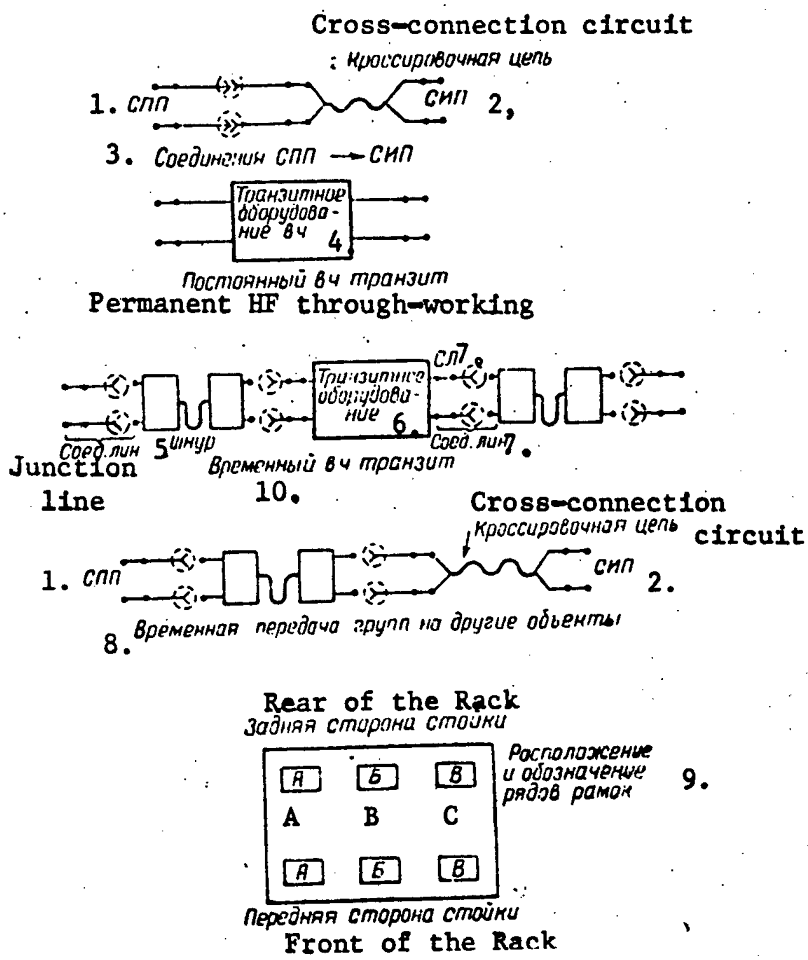


Figure 1.8.3. Connection configurations in the SKP-1 rack.

Key: 1. SPP [primary conversion rack];
2. SIP [individual conversion rack];
3. SPP to SIP connections;
4. High frequency through-working equipment;
5. Flexible cord [link];
6. Through-working equipment;
7. SL [junction line];
8. Temporary transmission of groups to other facilities;
9. Arrangement and designation of the rows of shelves;
10. Temporary HF through working.

1.9. The SKVT-1 Bay for Switching Secondary and Ternary Groups

Figures 1.9.1. - 1.9.4.

Purpose: Intended for switching the transmit and receive channels of 60-channel or 300-channel groups.

Capacity: Provides for the capability of simultaneous switching by means of cross-connections and 20 junction lines of 30 60-channel or 300-channel groups for the transmit direction and 30 of the same groups for the receive direction.

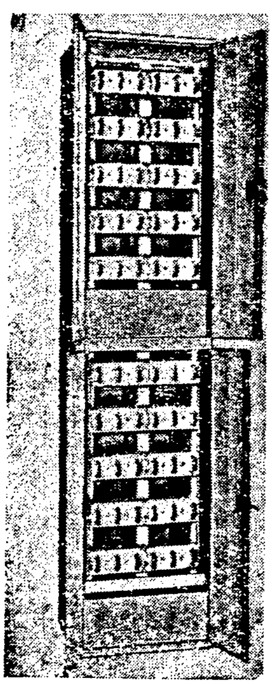
Equipment Complement:

Placed in the top part of the rack is the transmit route equipment, and the receive route equipment is housed in the lower part. There is a slide-out box, divided into two sections, which is intended for storing removable parts, in the lower part of the rack on the front side. Mounted on the front of the rack for both transmit directions in rows A and B are 20 boards with coaxial connectors. Mounted on the rear of the rack in rows C, D and E are 26 shielded shelves.

Construction:

The rack is made in the form of a cabinet. The rack dimensions are 2,600 x x 650 x 580 mm. The cabinet construction allows for the option of coupling two and more racks together. Switching the channels by means of coaxial jumpers is accomplished on front of the rack, while switching by means of resoldering is carried out in the rear.

Weight: 200 Kg; Cost: 2,400 rubles.



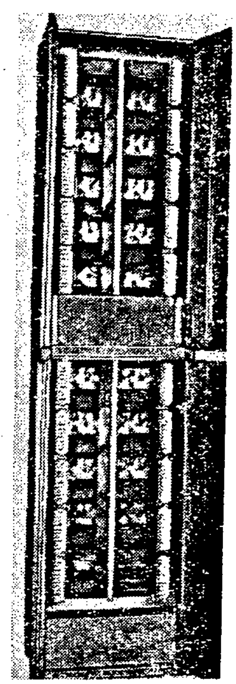


Figure 1.9.1.

Exterior view of the SKVT-1 secondary and ternary group switching rack.

a) View from the front;

b) View from the rear.

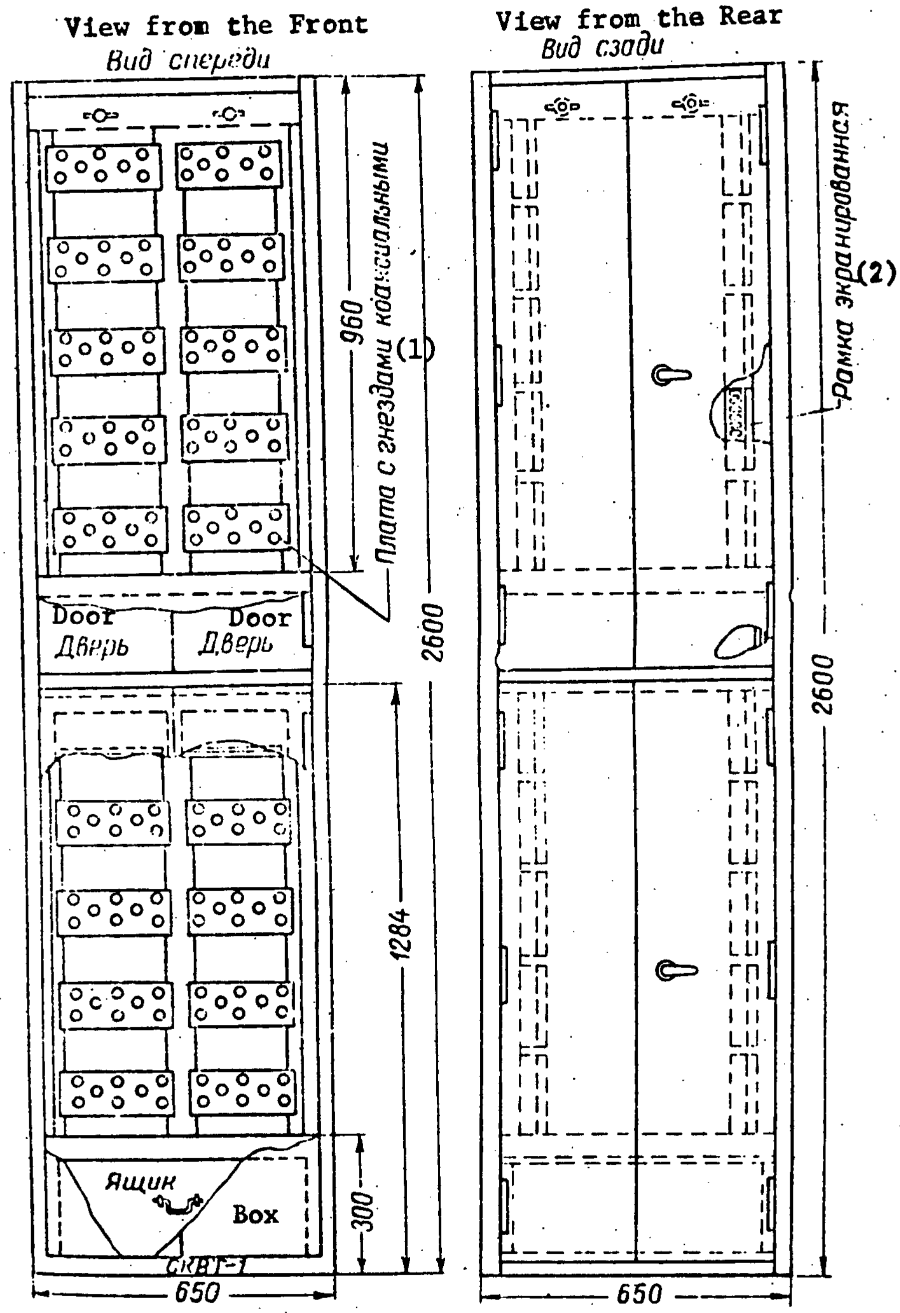


Figure 1.9.2. The placement of the equipment components in the SKVT-1 secondary and ternary group switching rack.

Key: 1. Panel with coaxial connectors;
2. Shielded shelf.

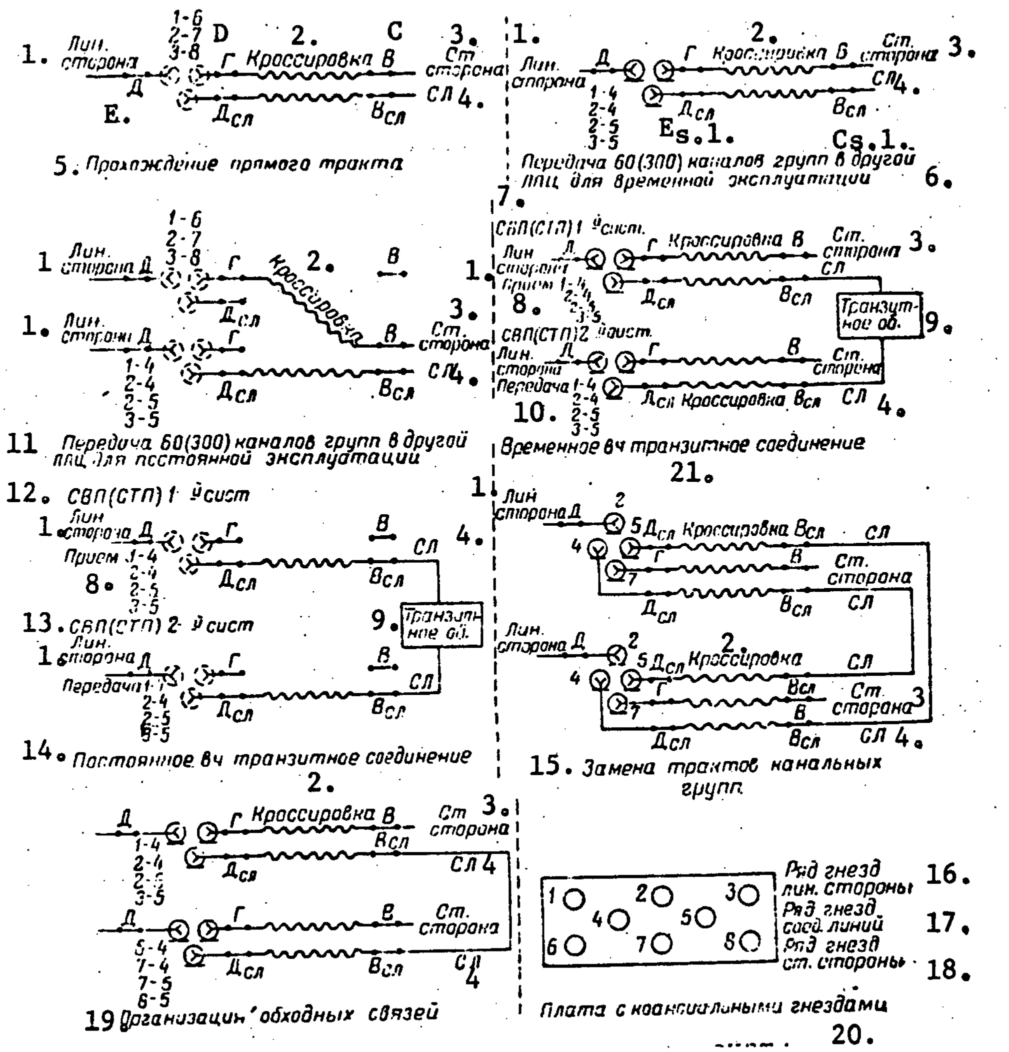


Figure 1.9.3. The connection configurations in the SKVT-1 rack.

Key:
1. Line end;
2. Cross-connection field;
3. Exchange end;
4. SL [junction line];
5. Straight-through channel passage;
6. The transmission of 60 (or 300) group channels to another line equipment shop for temporary service;
7. SVP (STP) [secondary conversion rack (or ternary conversion rack)] of the first system;
8. Receive;
9. Through-working equipment;
10. Transmit;
11. The transmission of 60 (or 300) group channels to another line equipment shop for permanent service;
12. SVP (STP) of the first system;
13. SVP (STP) of the second system;
14. Permanent HF through call connection;
15. Substitution of the channels of the channel groups;
16. Row of jacks of the line end;

[Key to Figure 1.9.3, continued]:

17. Row of junction line jacks;
18. Row of exchange end jacks;
19. The organization of bypass routes;
20. Panel with coaxial connectors;
21. Temporary high frequency through-call connection.

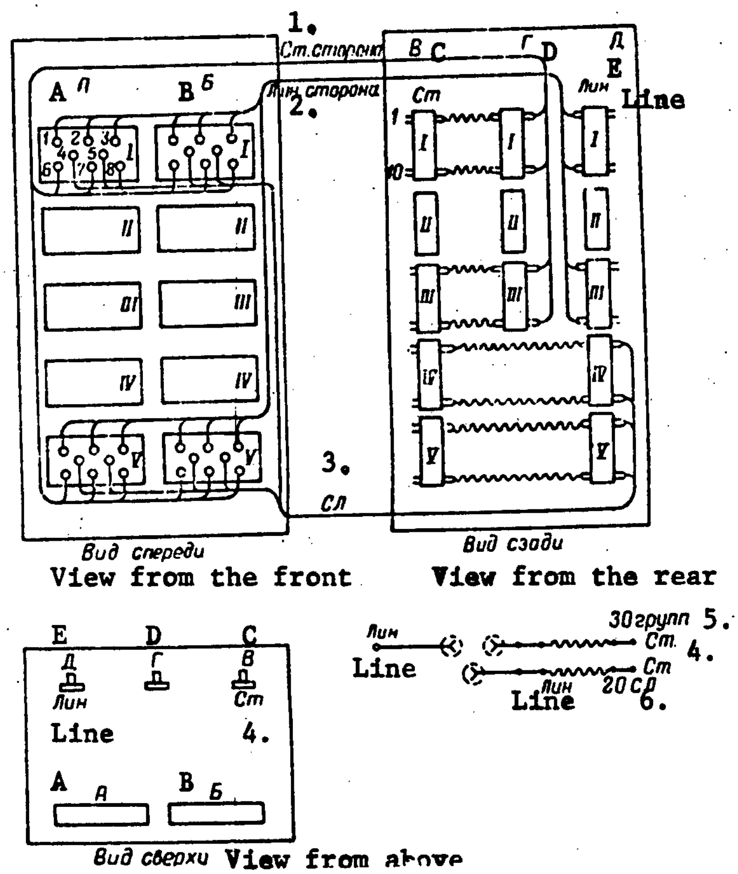


Figure 1.9.4. Internal wiring of the SKVT-1 rack (simplified wiring schematic for one transmission direction).

Key: 1. Exchange end;
2. Line end;
3. SL [Junction line];
4. Exchange;
5. 30 groups;
6. 20 junction lines.

1.10. The SPM Intermediate Service Rack — Figures 1.10.1. - 1.10.3.

Purpose: Intended for switching, checking and measuring telephone and telegraph communications channels.

Capacity: Designed for connecting 288 channels in a two-wire circuit or 144 channels in a four-wire circuit configuration.
The temporary switching of the channels is accomplished with flexible cords, while the permanent switching is realized with U-links.

Equipment Complement:

Power Supply Panel. Four removable panels with four types of jacks (the jack type is agreed on when ordering).

Junction Line Panel.

PVU [intercom-callup unit] Panel. The following are placed on the PVU panel:

Five sets of local battery service lines, one set for communications with an automatic telephone exchange, a set of junction lines and a P-321 measurement instrument (generator and level meter). The PVU is connected via both two-wire and four-wire circuits.

Amplifier Panel with Dynamic Loudspeaker. The amplifier for the dynamic loudspeaker is transistorized.

Notes:
1. The plant (if the type of boards are not agreed on when ordering) installs boards with single-wire jacks and twin miniature links. The exchange cable is connected directly into the panel jacks.
2. The plant supplies boards of any type of jacks separately on order.
3. A place is provided for the mounting of the UNP-60 measurement instrument [psophometric noise meter].
4. The maximum equipment complement of the SPM provides for the installation of five boards of jacks (without the PVU board).

Current Consumption:

For powering the PVU and the P-321 instrument: 2.5 amperes at 24 volts for the filaments, and 0.2 amperes at 220 volts for the plates. The ring circuits are powered from a 127/220 volt transformer.

Construction:

The rack is built on a frame of steel channels. The rack dimensions are 2,500 x 648 x 800 mm.

Weight (without the boards): 150 kg.

Cost (without the boards): 248 rubles.

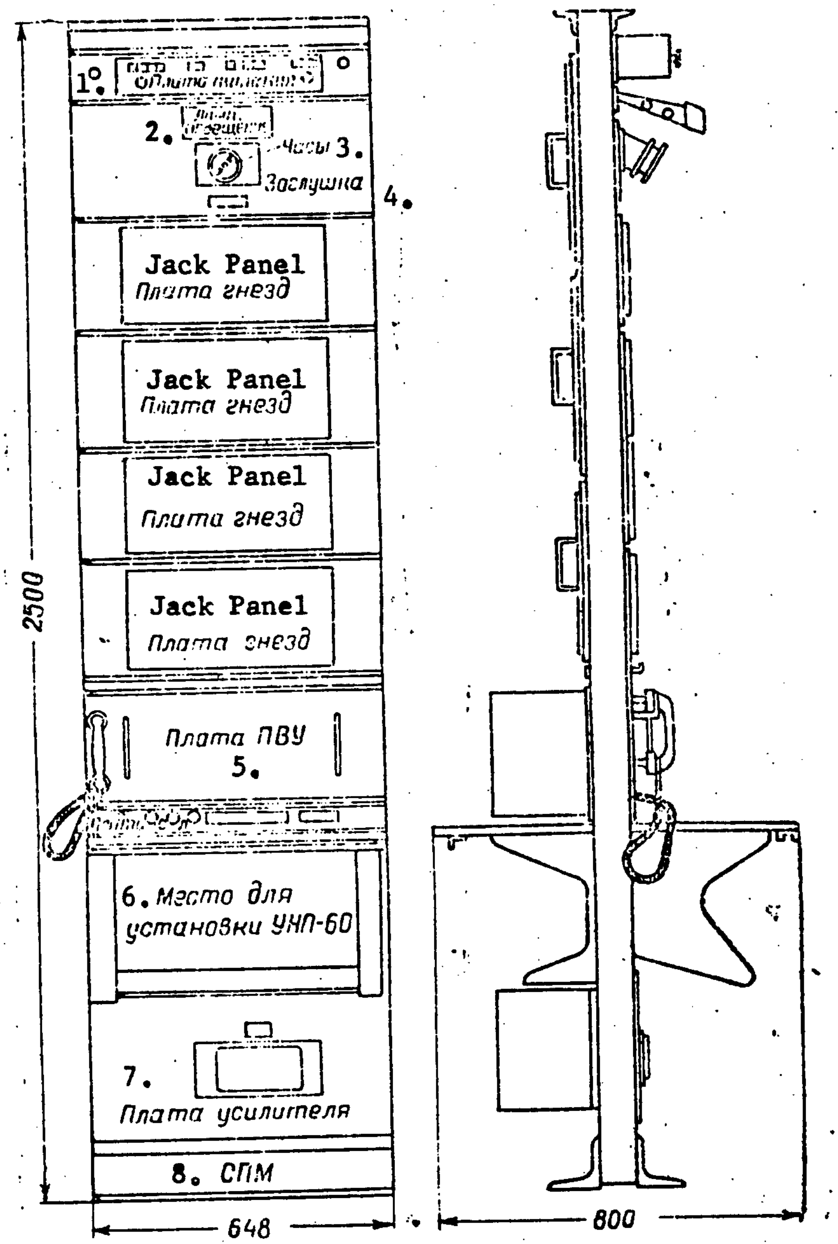


Figure 1.10.1. The equipment layout in the SPM intermediate service rack.

Key:
1. Power supply panel;
2. Panel light;
3. Clock;
4. Blank panel;
5. Intercom-callup unit panel;
6. Place for the installation of the UNP-60;
7. Amplifier panel;
8. SPM [intermediate service rack].

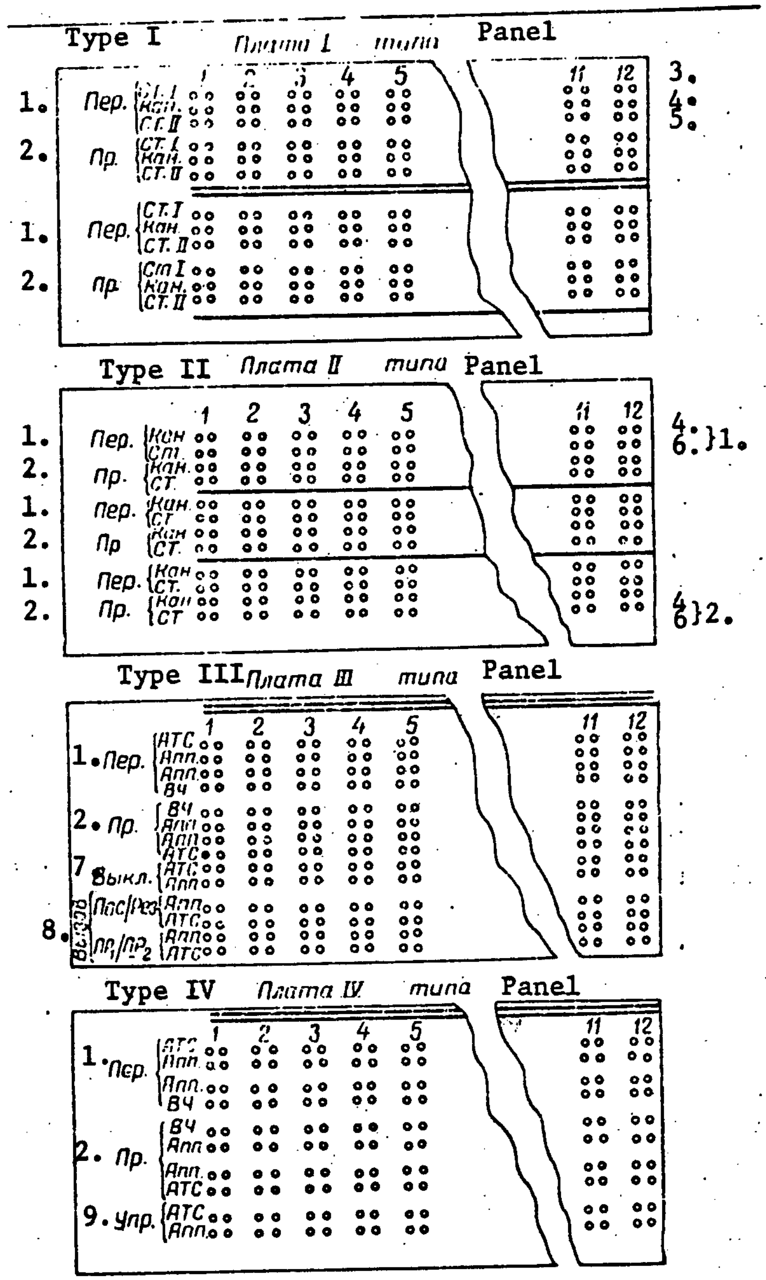


Figure 1.10.2. The arrangement of the jacks on the panels of the SPM rack.

Key:
1. Transmit;
2. Receive;
3. Station I;
4. Channel;
5. Station II
6. Station;
7. Disconnect;
8. Ring;
9. Control;

АТС = Automatic telephone exchange;
Апп = Telephone set;
ВЧ = High frequency.

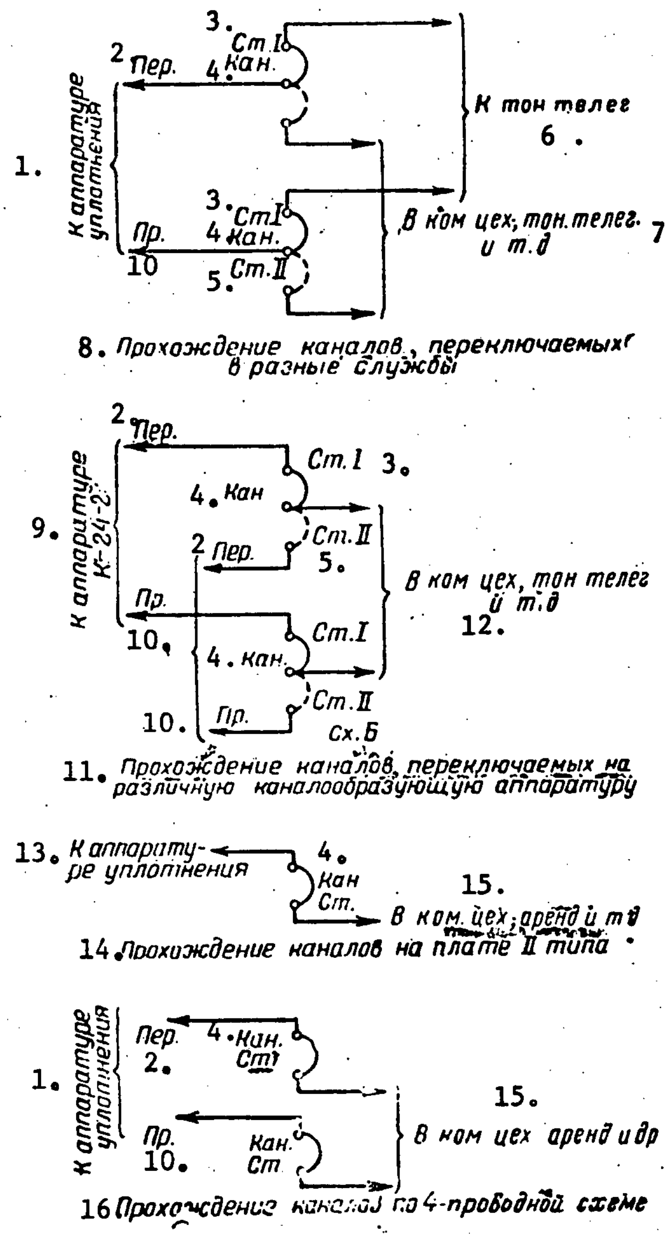


Figure 1.10. Channel connection circuits on type I and II boards of the SPM rack.

Key:
1. To the multiplex equipment;
2. Transmit;
3. Station I;
4. Channel;
5. Station II;
6. To voice frequency telegraphy;
7. To switching shop, VF telegraphy, etc.;
8. Through passage of channels, switched to various services;
9. To the K-24-2 equipment;
10. Receive;
11. Through passage of channels, switched to different channel generating equipment;
12. To switching shops, voice frequency telegraphy, etc.;
13. To multiplex equipment;
14. Through passage of channels to a type II board;

[Key to Figure 1.10.3., continued]:

15. To switching shops; leased lines, etc.
16. Through passage of channels via a four wire circuit.

1.11. The SChK Four-Wire Switching Rack (taken out of production)

Figures 1.11.1, 1.11.2.

Purpose: Intended for connecting four-wire telephone channels, checking receive and transmit levels and establishing the residual attenuation in the channels. Conversations can be carried on from the rack through the channels, and the simplest measurements can be made with a neper meter.

Capacity: Designed for connecting up to 60 four-wire voice frequency channels.

Equipment Complement:

One to five panels for connecting four-wire channels. Each panel is designed for connecting 12 channels;
Panel for talkback circuits;
Neper meter;
Two 4-wire intercom-callup units;
Block of junction line jacks.

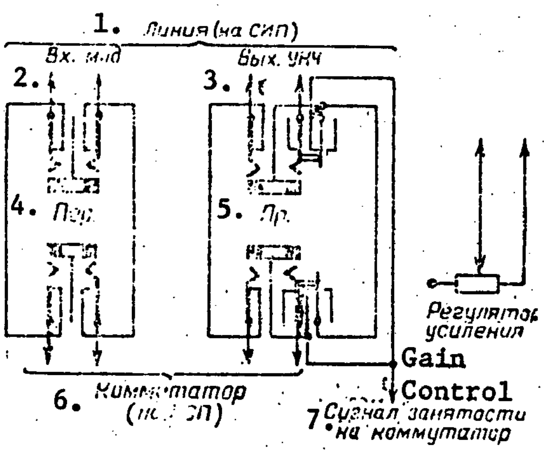


Figure 1.11.1. Schematic of the set for the connection of four-wire channels in the SChK rack.

Key: 1. Line (to the SIP [individual conversion equipment rack]);
2. Mod. Input;
3. Low frequency amplifier output;
4. Transmit;
5. Receive;
6. Switchboard (to [acronym lost with poor copy]);
7. Busy signal to switchboard.

Power Supply Voltages (for the neper meter):

Regulated or unregulated power sources at a voltage of:
Plate: 206 or 220 volts;
Filament: 21.2 or 24 volts.

Current Consumption: Plate: 0.01 amps regulated, 0.01 amps unregulated;
Filament: 0.64 amps regulated, 0.85 amps unregulated.

In determining the current consumption, it is conventionally assumed that the neper meter operates for four hours out of a 24 hour day.

Construction: The rack is built on a frame of steel channels with panels filling one side. The height of the slide-out desk from the floor is 770 mm, and it extends 250 mm out from the rack. The rack dimensions are 2,500 x 646 x 660 mm.

Weight: 250 kg (for the SChK-12).

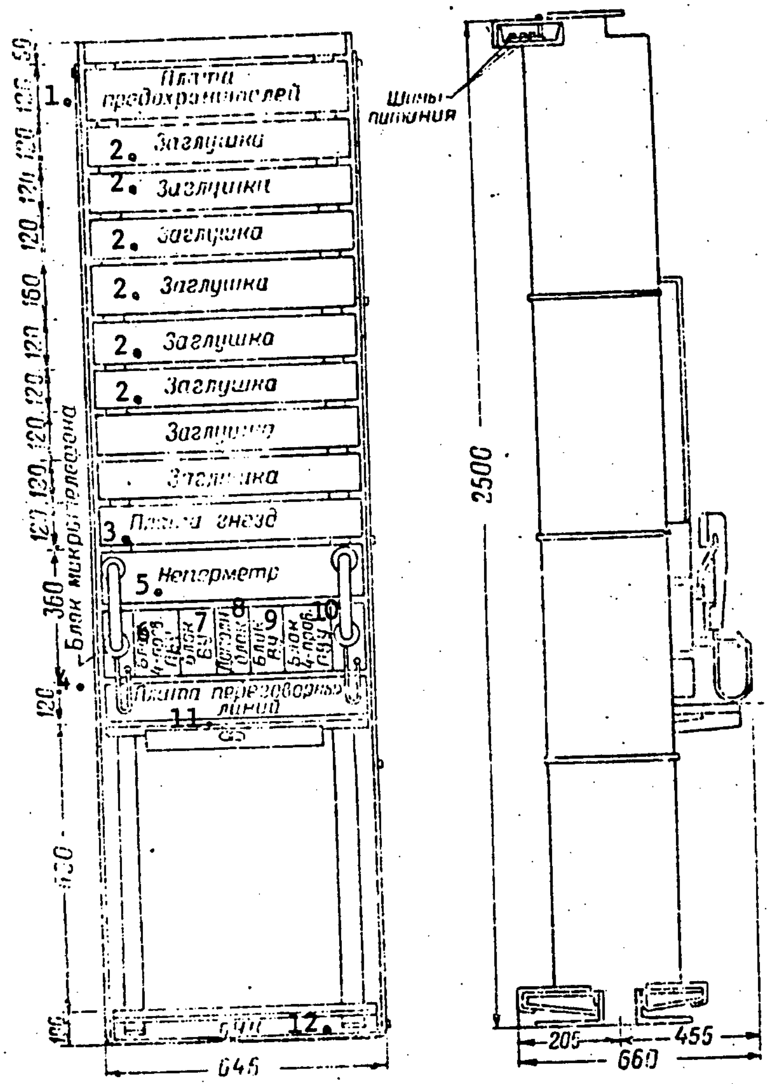


Figure 1.11.2. The equipment layout in the SChK four-wire switching rack.

Key: 1. Fuse panel;
2. Blank panel;
3. Jack panel;
4. Telephone handset block;
5. Neper meter;
6. Four-wire intercom-callup unit block;
7. Ringing block;
8. Supplemental block;
9. Ringing block;
10. Four-wire intercom-callup unit block;
11. Talkback circuit panel;
12. SChK [four-wire switching rack].

1.12. The VKS-VEF Cable Entrance Rack (taken out of production)

Figures 1.12.1, 1.12.2.

Purpose:

Intended for connecting balanced, long distance cables (trunk, junction line) and the cable inputs of open wire circuits; for the substitution of cable pairs; and for monitor measurements of the cable. Both coil-loaded and non-coil-loaded cables can be connected into the rack.

Notes: 1. When multiplexing a cable with transmission systems in a spectrum up to 108 KHz, installed in the rack for the physical circuits are 135:180 transformers, while 600:200 transformers are installed for phantom circuits. When low frequency cables are connected into the rack, installed for the physical circuits are 600:1,500 transformers, while 600:800 transformers are installed for the phantom circuits.

3. When multiplexing a non-coil-loaded cable with HF systems in a spectrum up to 108 KHz, the high and low level cables are connected into different racks.

Equipment Complement:

4 boxes of two terminal strips each. The capacity of an unshielded terminal strip is 10 x 2, and for a shielded one, 6 x 2 (the number of boxes and the type of terminal strips is agreed on when ordering).

2 input terminal blocks, 20 x 4.

45 RA-350 dischargers.

A 30 terminal board for feeding the remote power, 64 HF and low frequency transformers, bleeder coils and HF chokes.

Construction:

The rack is built on a frame of steel sections. The rack dimensions are 2,500 x 600 x 680 mm.

Weight: 104 kg.

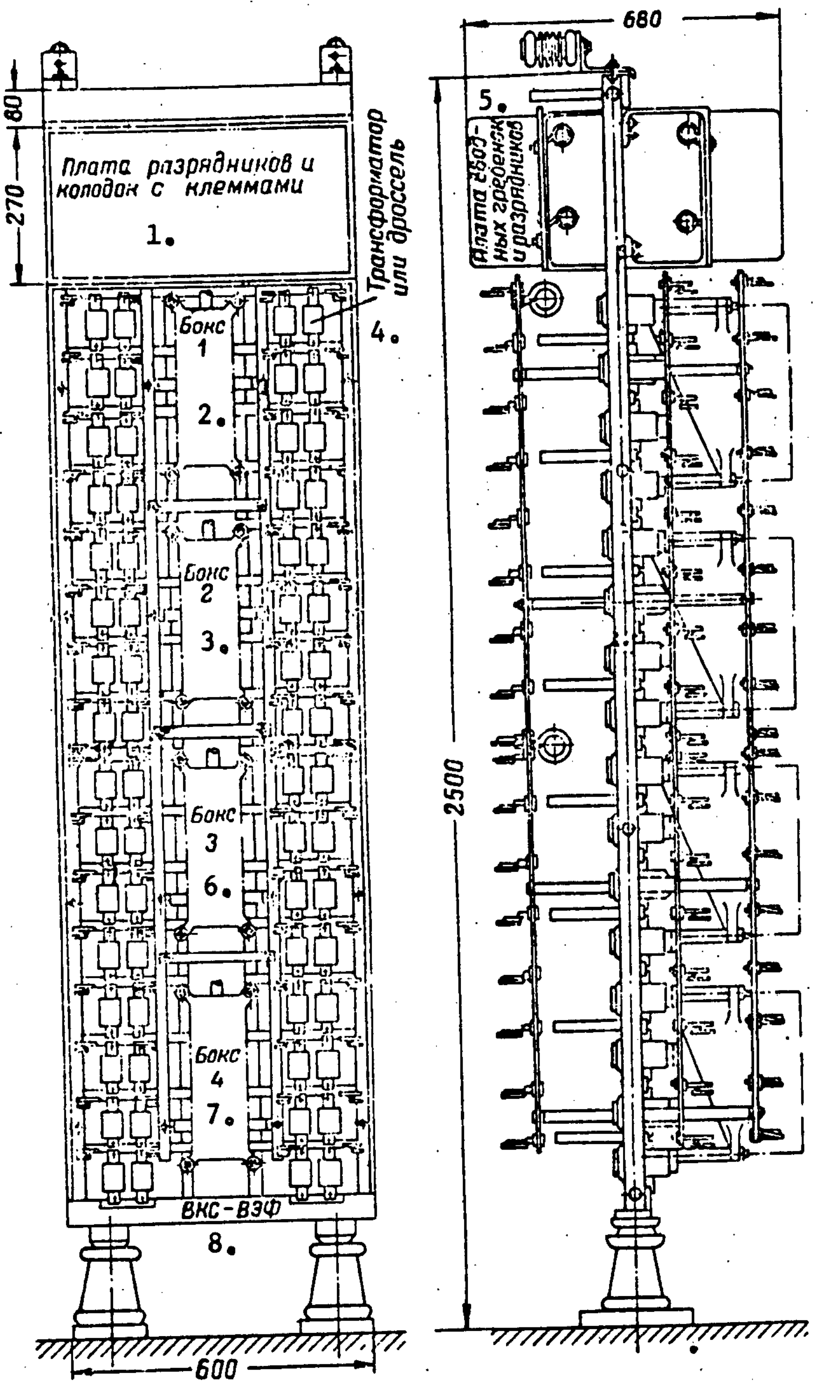


Figure 1.12.1. The placement of the equipment components in the VKS-VEF cable input rack.

Key: 1. Panel of dischargers and terminal blocks;
2. Box 1;
3. Box 2;

[Key to Figure 1.12.1, continued]:

4. Transformer or choke;
5. Panel of input terminal blocks and dischargers;
6. Box 3;
7. Box 4;
8. VKS-VEF.

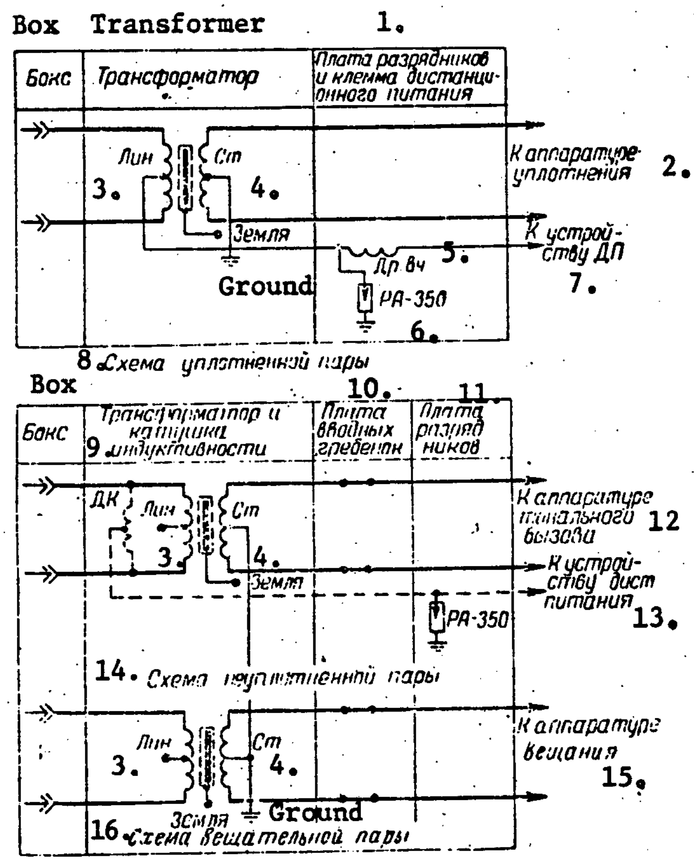


Figure 1.12.2. The schematic of the VKS-VEF cable input rack.

Key: 1. Panel of dischargers and the remote power supply terminals;
2. To the multiplex equipment;
3. Line;
4. Exchange;
5. High frequency choke;
6. RA-250 [discharger];
7. To the remote power supply unit;
8. Schematic for a multiplexed pair;
9. Transformer and inductance coil;
10. Panel of input terminal blocks;

[Key to Figure 1,12.2, continued]:

11. Discharger panel;
12. To voice frequency ring equipment;
13. To the remote power supply unit;
14. Schematic of an unmultiplexed pair;
15. To broadcast equipment;
16. Schematic of a broadcast pair.

1.13. The VKS-OUP and VKS-NUP Cable Input Rack for Balanced Cables for Attended and Unattended Repeater Stations.

Figure 1.13.1 - 1.13.10.

Purpose: Intended for connecting two high frequency balanced cables, multiplexed up to 252 KHz.

Capacity: VKS 4 x 4 OUP [attended repeater station], VKS 4 x 4 NUP [unattended repeater station]: Each for the connection of two 4 x 4 high level cables.

VKS-1 4 x 4 OUP, VKS-1 4 x 4 NUP: Each for the connection of two 4 x 4 low level cables.

VKS 7 x 4 OUP, VKS 7 x 4 NUP: Each for the connection of two 7 x 4 high level cables.

VKS-1 7 x 4 OUP, VKS-1 7 x 4 NUP: Each for the connection of two 7 x 4 low level cables.

Equipment Complement:

VKS 4 x 4 OUP. A panel of two BM-1 cable boxes with two shielded 6 x 2 terminal strips
A panel of filters for the signal cores
A panel of low frequency terminal blocks
Eight VKO [cable entrance equipment] panels
Two boards of protection filters.

VKS-1 4 x 4 OUP: The same complement [as above], but space is additionally provided for the installation of two boards of balancing networks (ordered separately).

VKS 7 x 4 OUP: A panel of two BM-1 cable boxes with three shielded 6 x 2 terminal strips
A panel of filters for the signal cores
A panel of low frequency terminal blocks
14 cable entrance equipment boards
4 boards of protective filters.

VKS-1 7 x 4 OUP: The same complement, but space is additionally provided for the installation of two panels of balancing networks (ordered separately).

VKS 4 x 4 NUP: A panel of two BM-1 cable boxes with two shielded 6 x 2 terminal strips.
A panel of signal core filters.

VKS-1 4 x 4 NUP: With the same complement, but space is additionally provided for the installation of two balancing network panels (or dered separately).

VKS 7 x 4 NUP: A panel of two BM-1 cable boxes with three 6 x 2 terminal strips.
A panel of signal core filters.

VKS-1 7 x 4 NUP: With the same complement, but space is additionally provided for the installation of two panels of balancing networks (ordered separately).

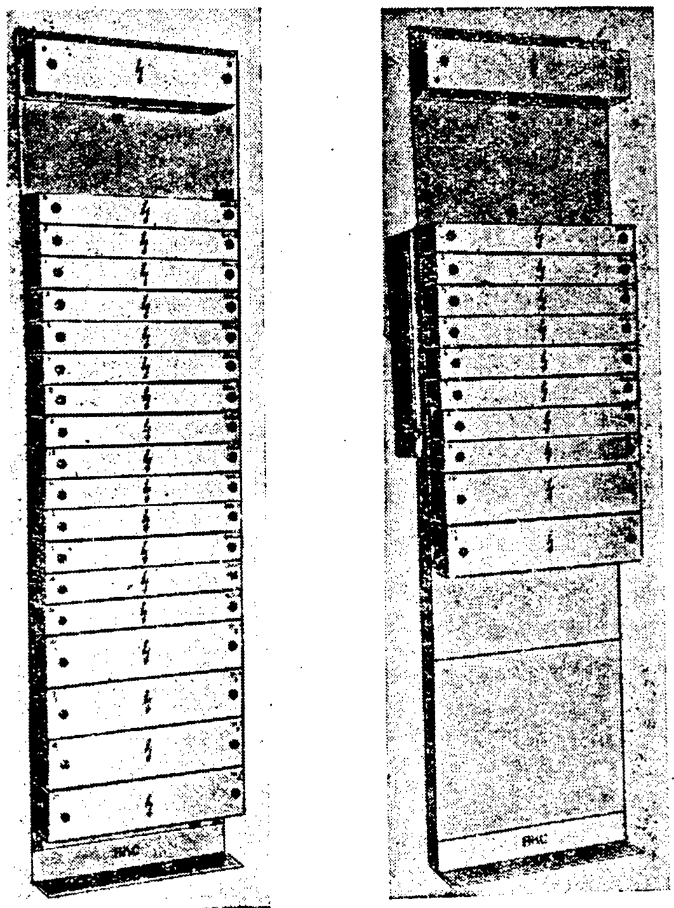
Notes: 1. Mounted on the VKO boards are 135:180 line transformers, a 600:200 transformer for the phantom circuits, and a D-8 filter (half-section).

2. The panels of balancing networks are not used at the present time.

Construction: The rack for the NUP [unattended repeater station] is built around a frame of angle steel, and the one for the OUP [attended repeater station] is built around a frame of steel channels.
Rack dimensions: VKS OUP: 2,500 x 644 x 492 mm
VKS NUP: 2,500 x 644 x 255 mm

Weight and Cost

Rack	Weight, kg	Price, rubles
VKS 4 x 4 OUP	270	714
VKS-1 4 x 4 OUP (with the balancing network panels)	300	1,030
VKS 7 x 4 OUP	270	1,101
VKS-1 7 x 4 OUP (with the balancing network panels)	415	1,898
VKS 4 x 4 NUP	60	163
VKS-1 4 x 4 NUP (with the balancing network panels)	105	535
VKS 7 x 4 NUP	65	176
VKS-1 7 x 4 NUP (with the balancing network panels)	118	982



(a) (b)

Figure 1.13.1. External view of the cable input racks:

(a) The VKS 7 x 4 OUP;
(b) The VKS 4 x 4 OUP.

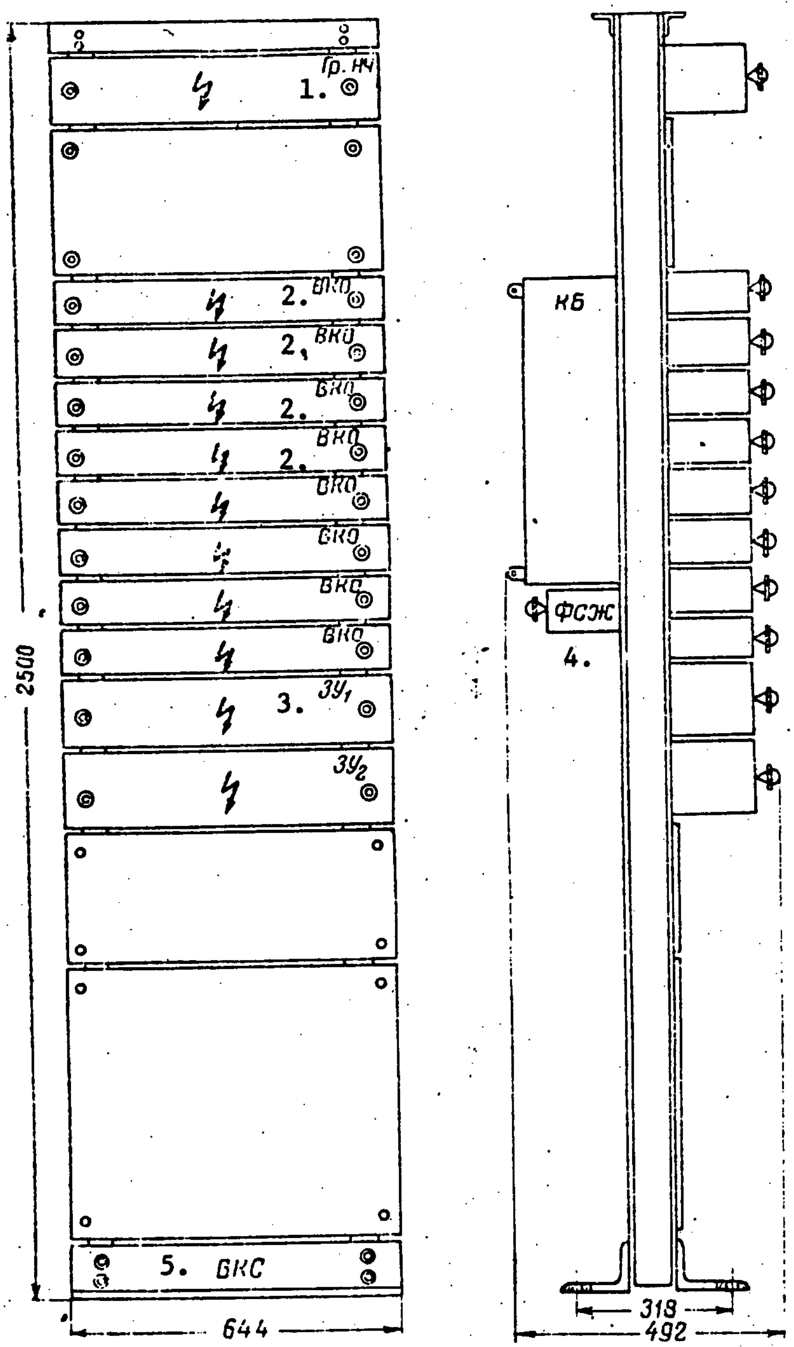


Figure 1.13.2. The placement of the equipment components in the VKS 4 x 4 OUP cable input rack.

Key: 1. Gr NCh [low frequency terminal blocks];
2. VKO [cable entrance equipment];
3. ZU_1 [protective filter panel 1]
4. FSZh [filters for the signal cores];
5. VKS [cable entrance rack].

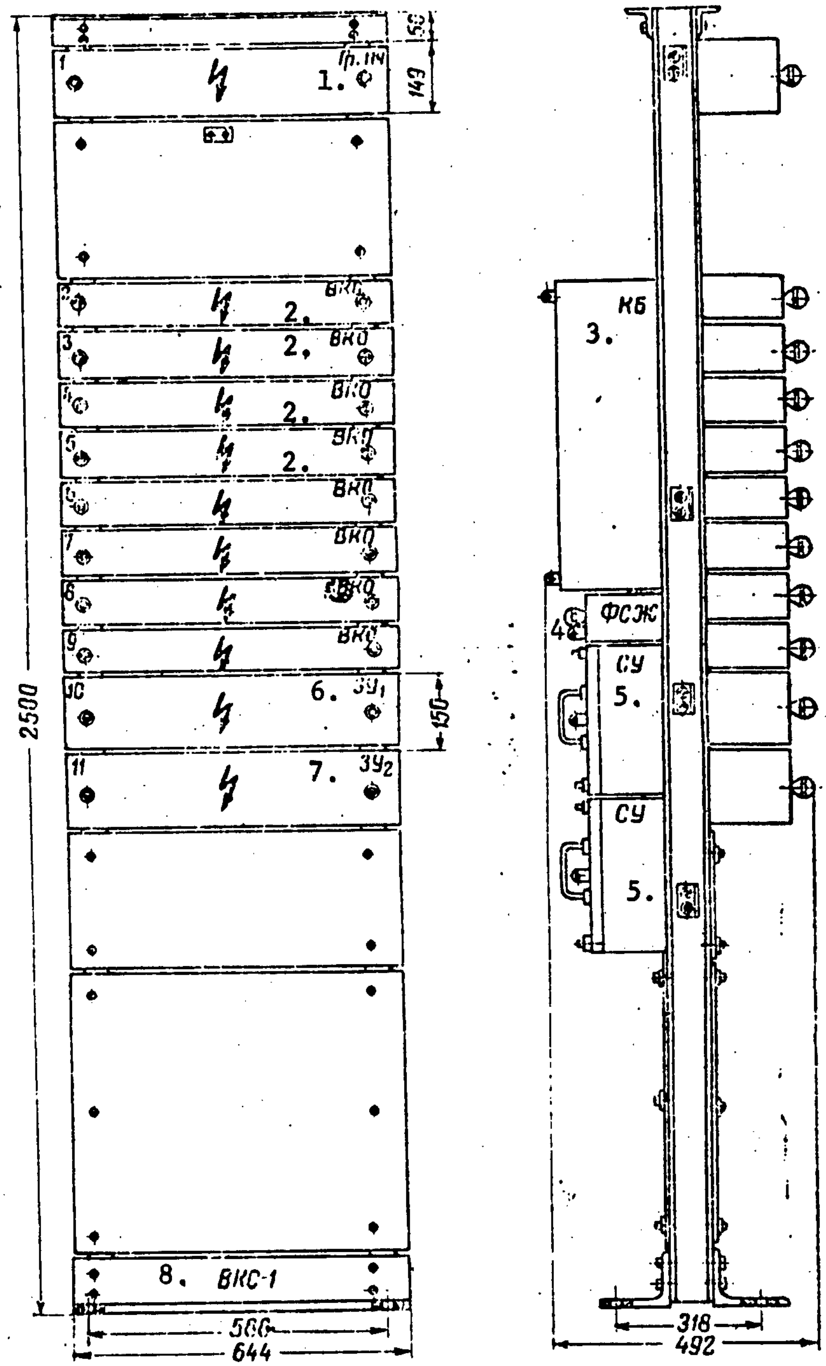


Figure 1.13.3. The placement of the equipment components in the VKS-1 4 x 4 OUP cable input rack.

Key:
1. Low frequency terminal blocks;
2. Cable entrance equipment panels;
3. Cable box;
4. Filter for the signal cores;
5. Balancing networks;
6. Protective filter panel 1;
7. Protective filter panel 2;
8. VKS - 1.

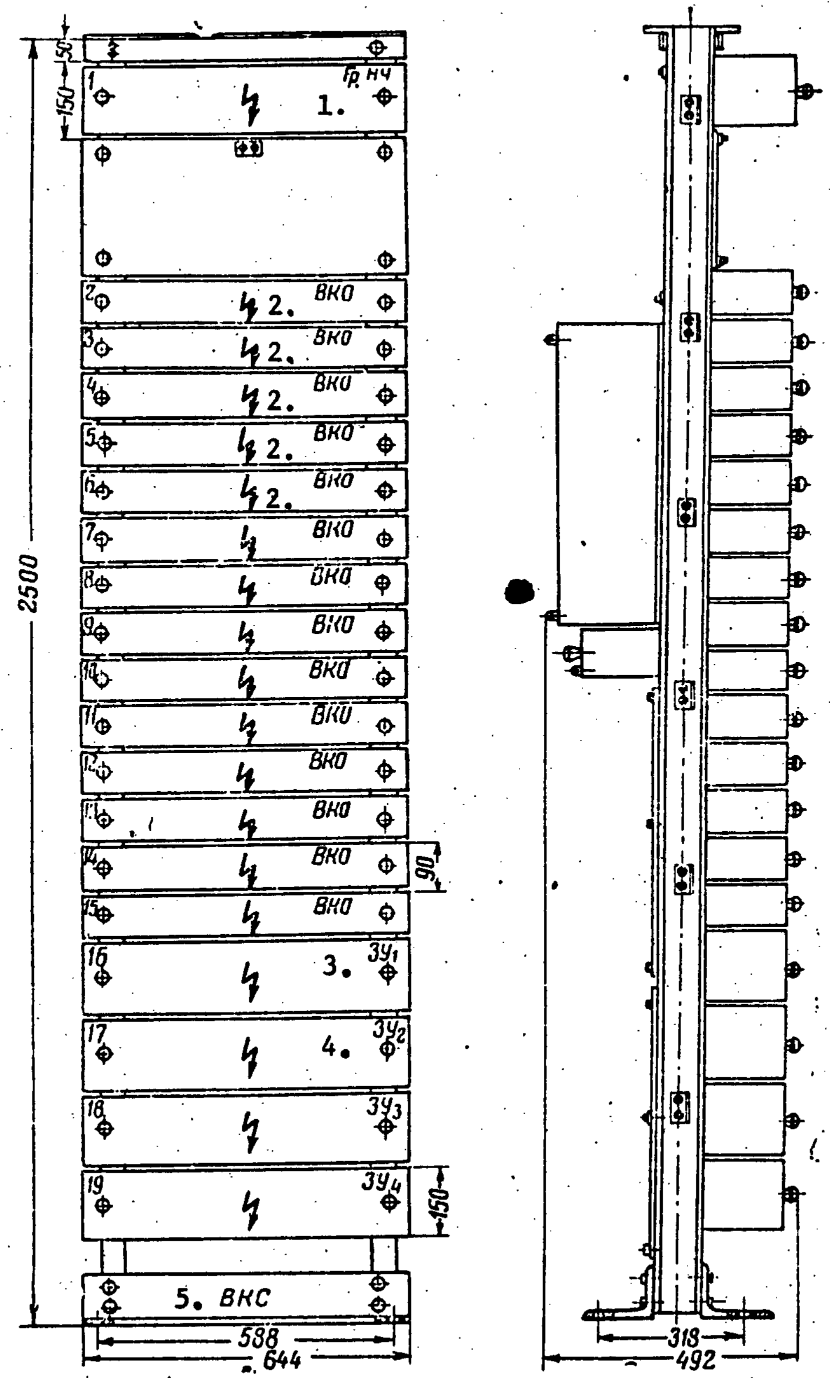


Figure 1.13.4. The placement of the equipment components in the VKS 7 x 4 OUP cable input rack.

Key: 1. Low frequency terminal blocks;
2. Cable entrance equipment panels;
3. Protective filter panel 1;
4. Protective filter panel 2;
5. VKS.

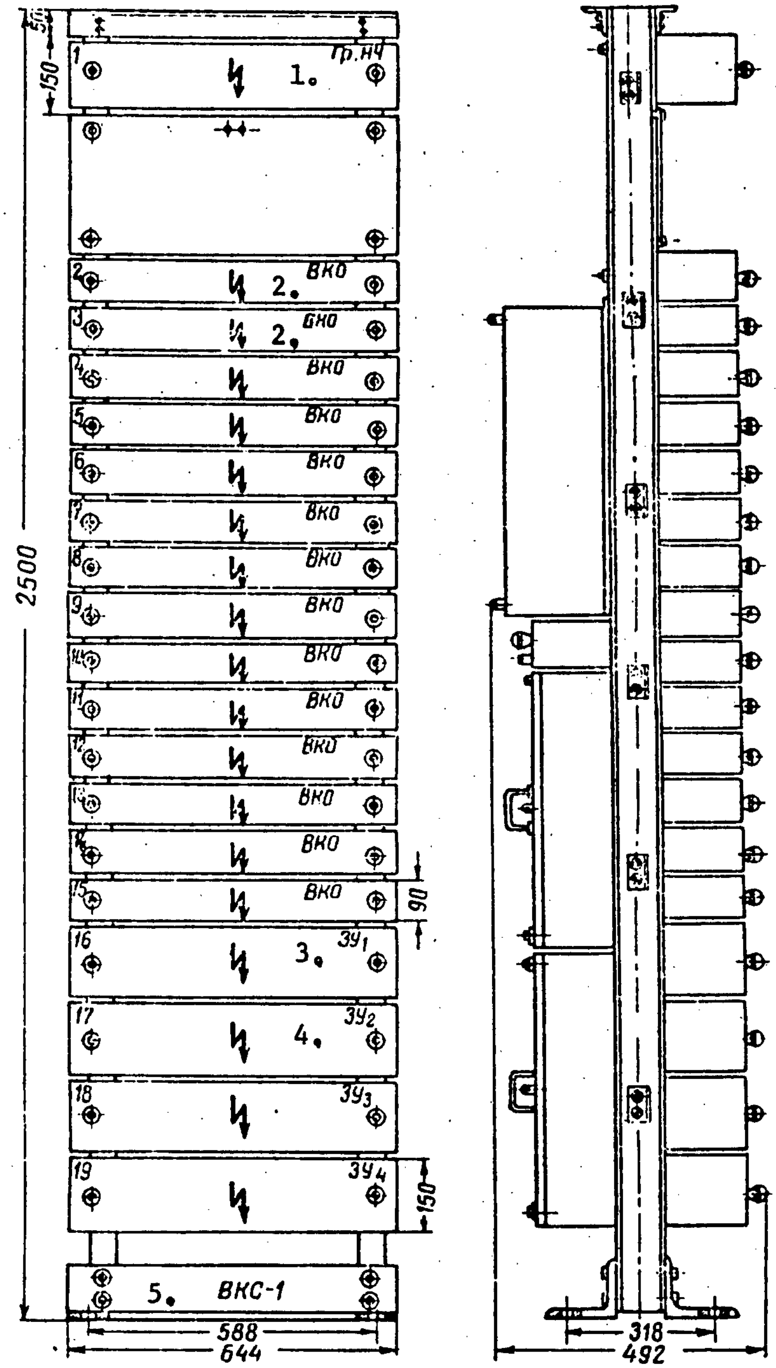


Figure 1.13.5. The placement of the equipment components in the VKS-1 7 x 4 OUP cable input rack.

Key: 1. Low frequency terminal blocks;
2. Cable entrance equipment panels;
3. Protective filter panel 1;
4. Protective filter panel 2;
5. VKS-1.

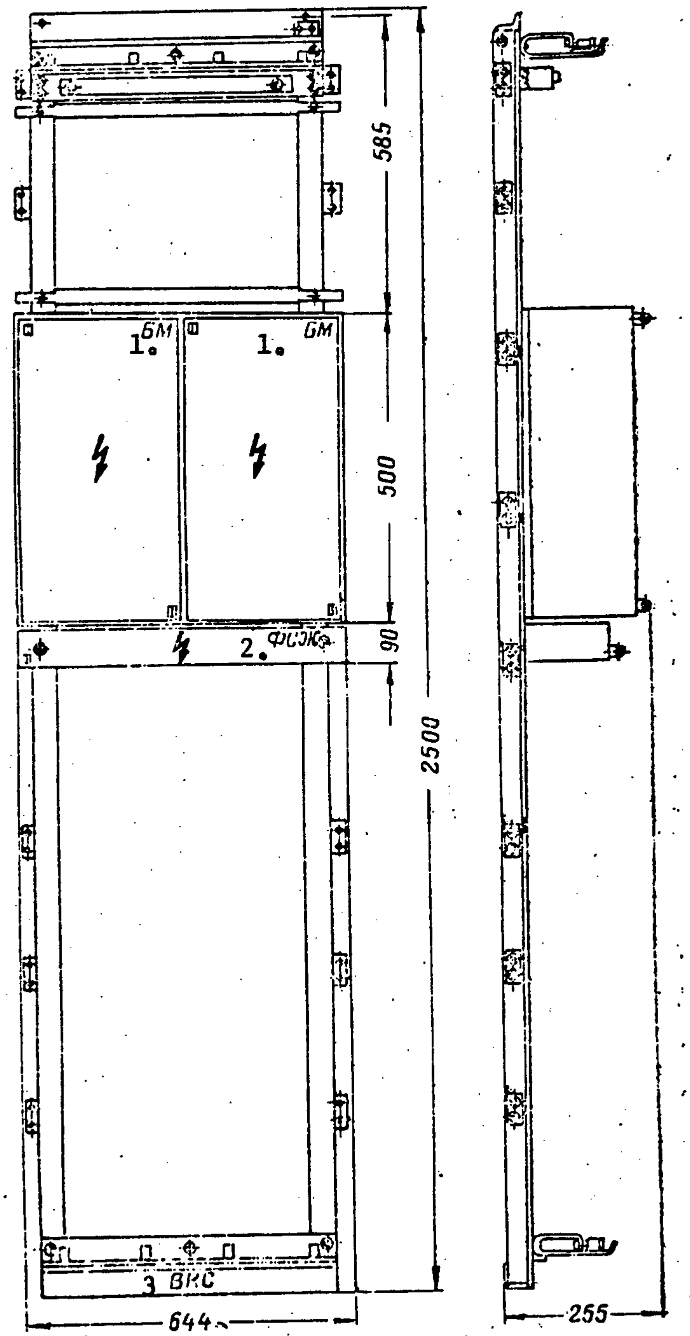


Figure 1.13.6. The placement of the equipment components in the VKS 4 x 4 NUP cable input rack.

Key: 1. Cable box panel;
2. Filter for the signal cores;
3. VKS [cable input rack].

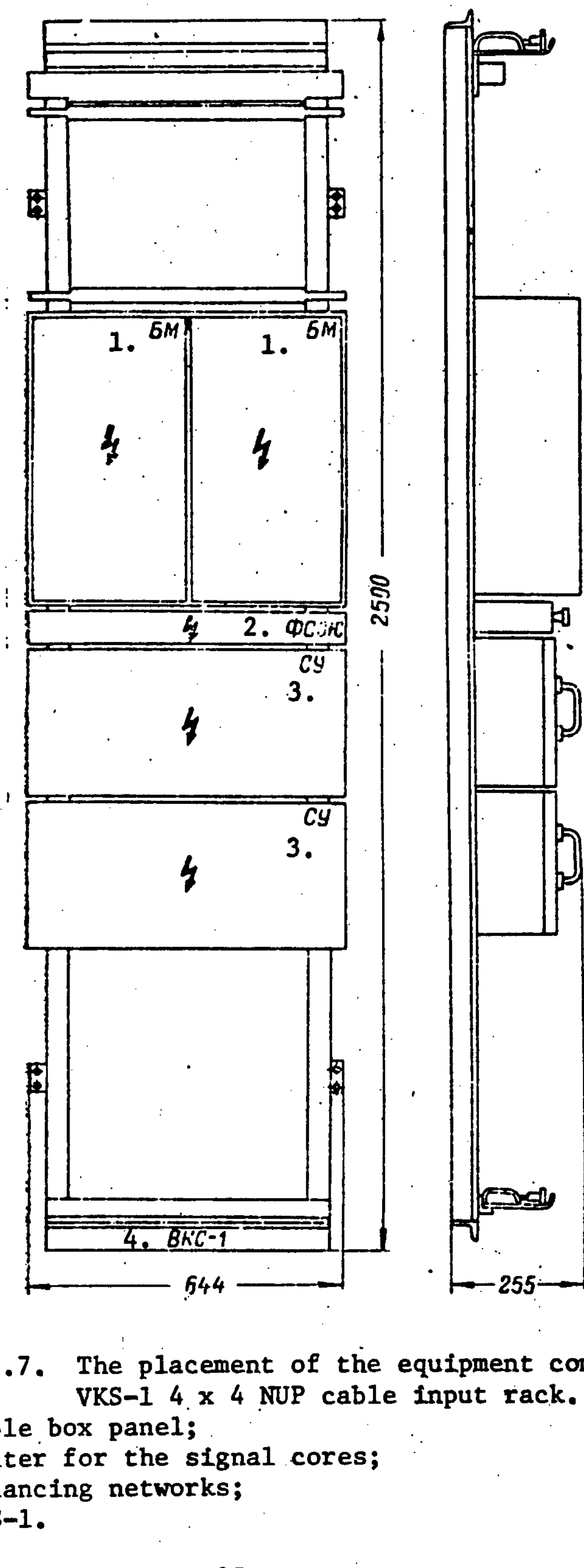


Figure 1.13.7. The placement of the equipment components in the VKS-1 4 x 4 NUP cable input rack.

Key: 1. Cable box panel;
2. Filter for the signal cores;
3. Balancing networks;
4. VKS-1.

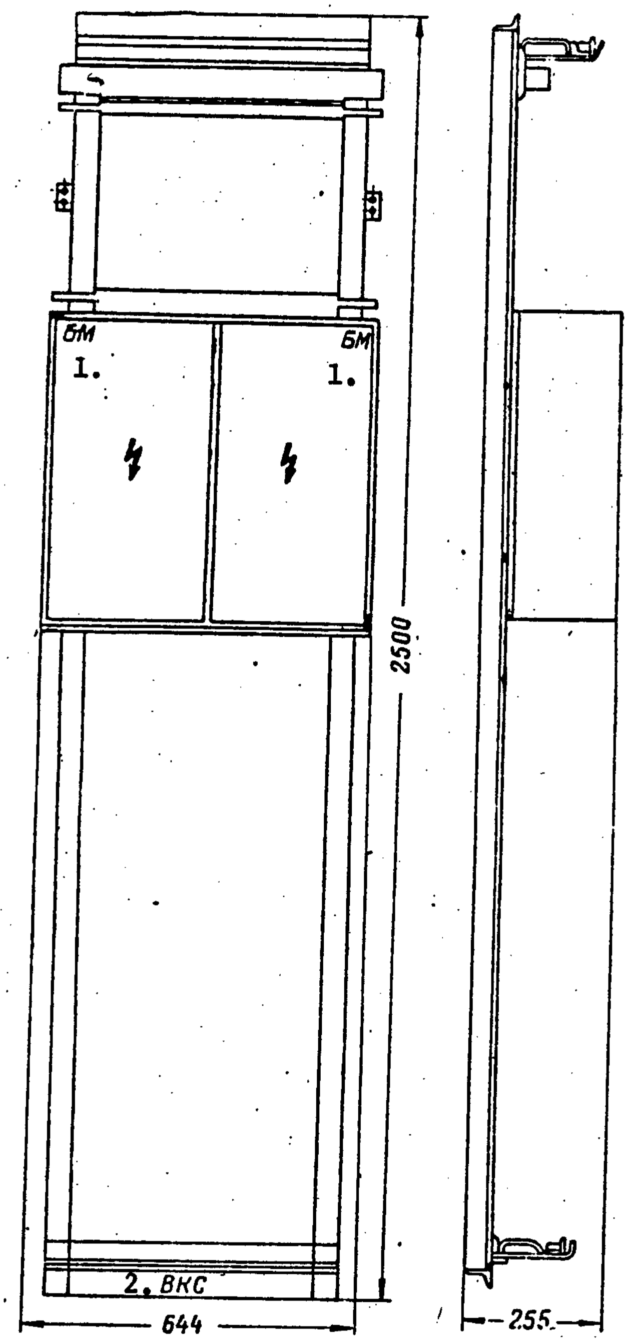


Figure 1.13.8. The placement of the equipment components in the VKS 7 x 4 NUP cable input rack.
Key: 1. Cable box panel;
2. VKS.

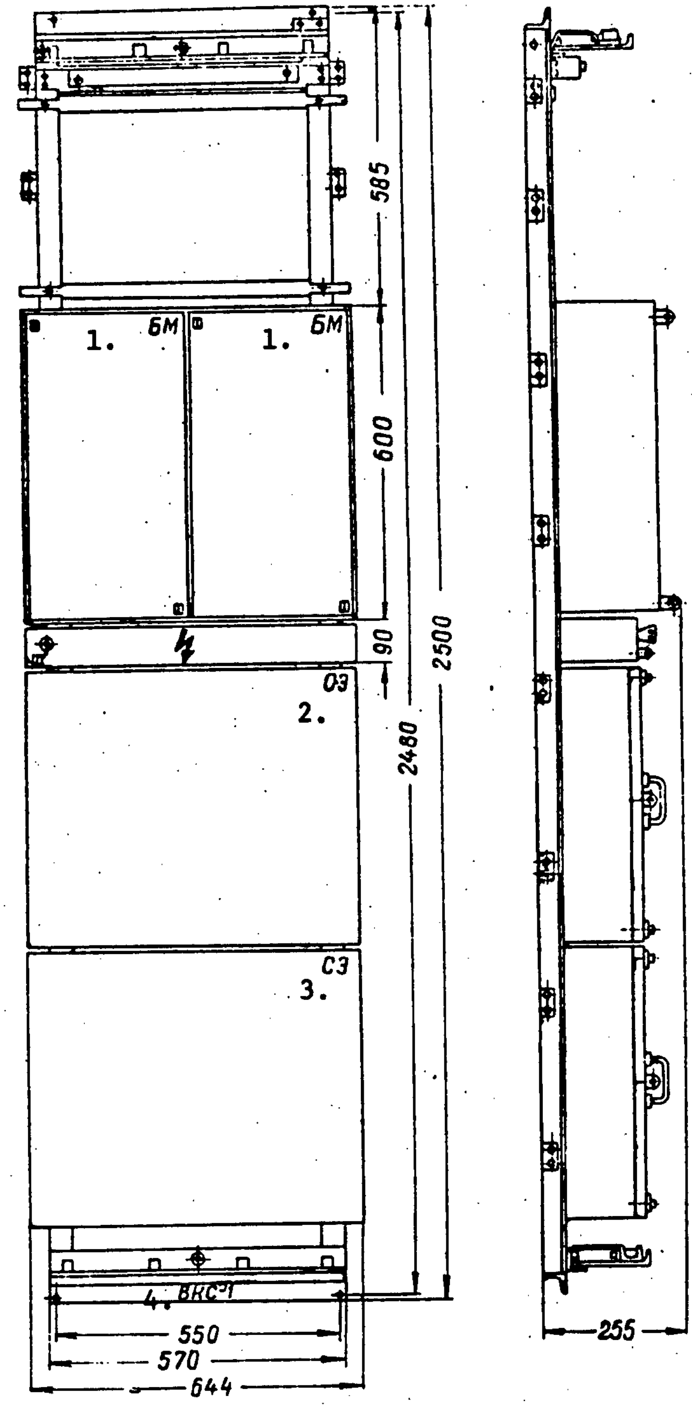


Figure 1.13.9. The placement of the equipment components in the VKS-1 7 x 4 NUP cable input rack.

Key: 1. Cable box panel;
2. SE [?balancing elements?]
3. SE
4. VKS-1.

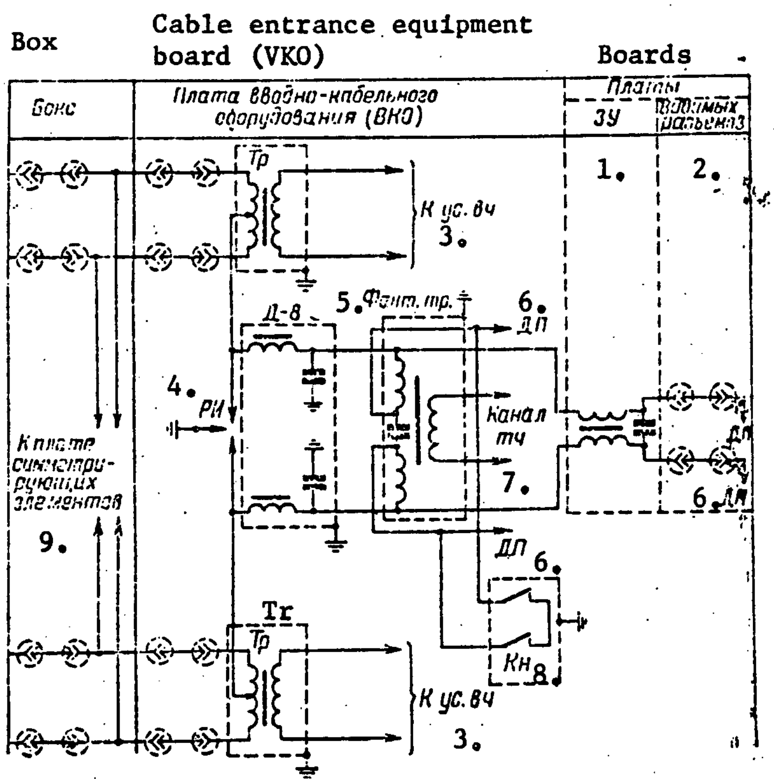


Figure 1.13.10. Schematic of the VKS-OUP rack [cable entrance rack—attended repeater station].

Key: 1. Protective filter unit;
2. Visible plug connectors;
3. To the HF amplifier;
4. RI [expansion unknown]
5. Phantom transformer;
6. Remote power;
7. Voice frequency channel;
8. Key;
9. To the panel of balancing elements.

1.14. The VKS-S Cable Input Rack for Junction Cables (VKS-S1, VKS-S2)

Figures 1.14.1 - 1.14.4.

Purpose: Intended for the connection of junction cables between MTS [long distance telephone exchanges] and ATS [automatic telephone exchanges], MTS's and MTS's, ATS's and ATS's; fanning out a junction cable in boxes; switching or substituting individual cable pairs; connecting measurement equipment to the cables for performing test measurements; and the organization of phantom circuits. The VKS-S1 is intended for

connecting high frequency cables, which can be multiplexed up to 252 KHz, while the VKS-S2 is for low frequency cables, which can be multiplexed up to 10 KHz.

Capacity: VKS-S1. Designed for the connection of 72 pairs of a high frequency junction cable with a crosstalk attenuation between the circuits of no less than 16.5 nepers, something which makes it possible to connect high and low level cables into one rack.

VKS-S2. Designed for the connection of 108 pairs of low frequency junction cables with a crosstalk attenuation between the circuits of no less than 11 nepers.

Equipment Complement:

VKS-S1:

Line End:

4 type BM2-3 boxes with PE-6 terminal strips;
2 type BM1-2 boxes with PE-6 terminal strips.
Miniature input terminal blocks are installed in the top part of the racks.

Exchange End:

18 panels with 72 high frequency 180:135 transformers and 36 voice frequency 200:600 transformers.

Notes: 1. The plant supplies a rack with 14 panels of transformers (56 180:135 transformers and 28 200:600 transformers).
2. A supplemental quantity of transformer panels is agreed on when ordering (a maximum of up to 18 panels).
3. Regardless of the number of transformer panels supplied by the plant, run in the rack frame is intrarack wiring (cable wiring) for rack operation at full capacity.
4. A rack can be supplied without transformer panels, with single boxes. In this case, the cabled wiring is not included in the equipment complement.

VKS-S2:

Line End:

6 type BM1-2 boxes with type PN-10 terminal strips.

Exchange End:

6 panels with voice frequency 600:600 transformers with the center taps brought out.

Notes: 1. On the customer's request, the rack can be supplied without the transformer panels.
2. The panels of 600:600 transformers and the panels of transformers for coil-loaded circuits (with four 600:1500 transformers and two 600:800 transformers each) can be supplied separately on special order.

Construction: The racks are built around frames of steel channels. The overall dimensions of each rack are 2,600 x 644 x 500 mm. Provided on the racks are two terminals for the connection of ground wires, one of which is insulated from the rack chassis. The cables are brought into the boxes from above, and are soldered to the line contacts of the terminal strips.

Climatic Operational Conditions: At temperatures of from +10 to +35° C, and a relative humidity of up to 85%.

Weight and Cost

Equipment	Weight, kg	Price, rubles
VKS-S1, without the transformer panels	260	1,428
VKS-S2, without the transformer panels	260	345
A panel of transformers for the VKS-S1	16	82
A panel of transformers for non-coil-loaded cables (VKS-S2)	16	45
A panel of transformers for coil-loaded cables (VKS-S2)	16	67

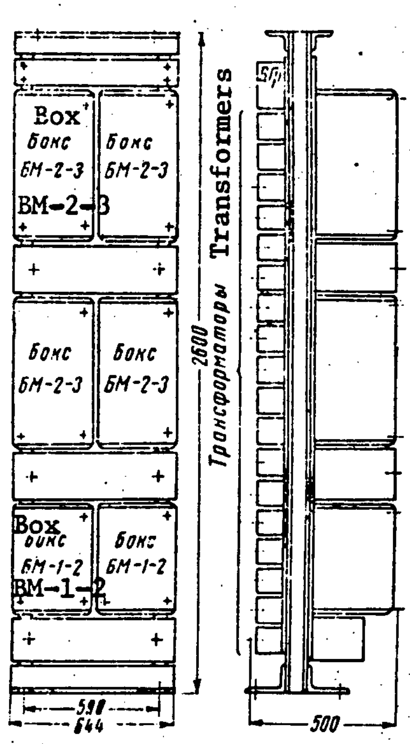


Figure 1.14.1. The placement of the equipment components in the VKS-S1 cable input rack.

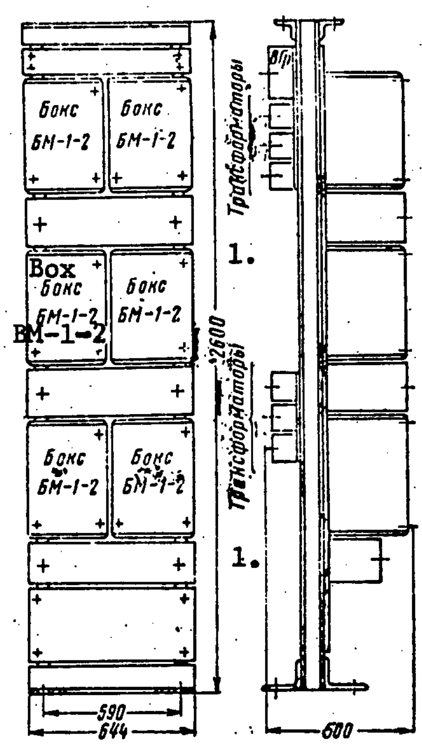


Figure 1.14.2. The placement of the equipment components in the VKS-S2 cable input rack.
Key: 1. Transformers;
Бгр = Input terminal blocks.

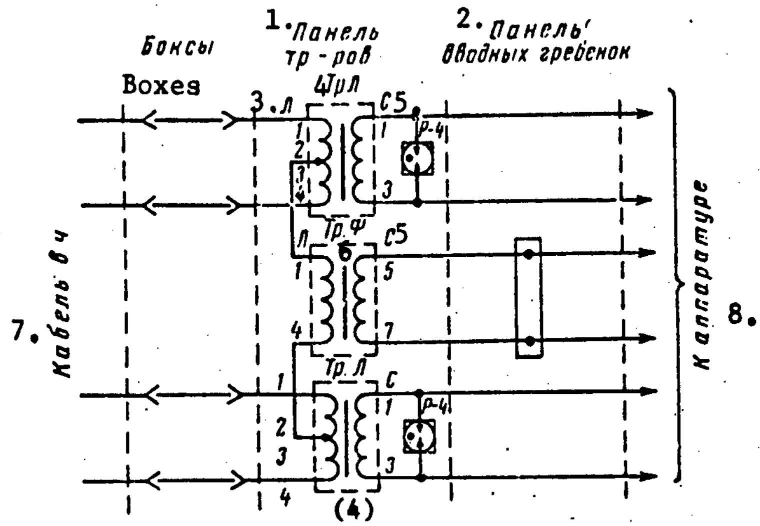


Figure 1.14.3. Schematic of the VKS-S1 cable input rack.

Key: 1. Panel of transformers;
2. Panel of input terminal blocks;
3. Line;
4. Line transformer;
5. Exchange;
6. To the equipment;
7. HF cable;
8. To the equipment.

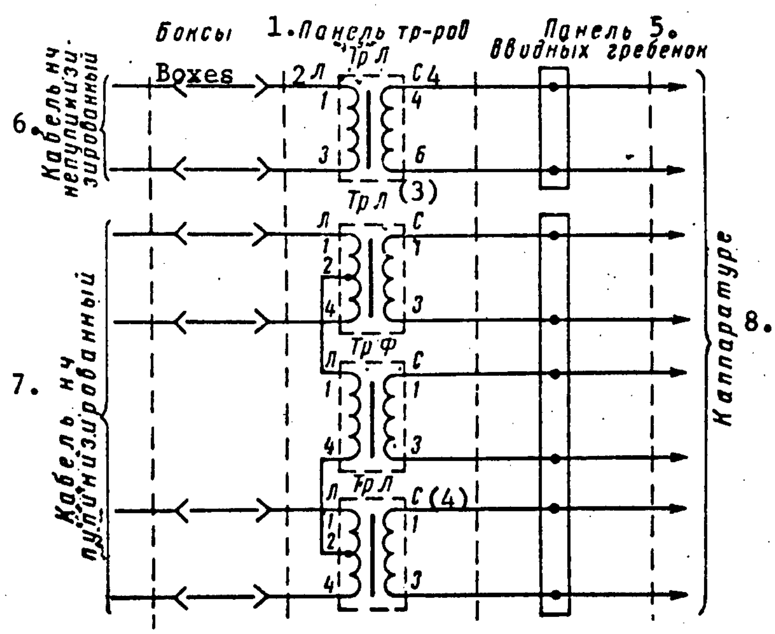


Figure 1.14.4. Schematic of the VKS-S2 cable input rack.

Key: 1. Panel of transformers;
2. Line;
3. Line transformer;
4. Exchange;
5. Panel of input terminal blocks;
6. Non-coil-loaded low frequency cable;
7. Coil-loaded low frequency cable;
8. To the equipment.

1.15. The VKS-OUP and VKS-OP Cable Input Racks for 1 x 4 Cable

Figures 1.15.1 - 1.15.4.

Purpose: Intended for connecting and servicing cables with a capacity of 1 x 4 having aluminum, lead or plastic jacketing, which can be multiplexed with the K-60 and K-60p equipment.

The racks provide for the following: the input and fanning out of long distance cables with a capacity of 1 x 4 x 1.2 at OP [terminal stations] and OUP [attended repeater stations]; the organization of HF and low frequency (phantom) circuits; the formation of circuits and the transmission of remote power at voltages up to 450 volts DC via "pair—pair", "Quad--quad" and "quad--ground" circuits; the protection of station devices and operational personnel against dangerous and interfering voltages; the switching and substitition of individual cable pairs; the performance of check measurements of the cables; and the switching and substitution of remote power supply circuits.

Electrical Characteristics:

The working attenuation of the HF channel (VKO) in a frequency range of 12 - 252 KHz	0.1 Np
The nominal value of the input impedance of the HF channel:	
MKV 1 x 4 x 1.2 cables from the:	
Line end	145 ohms
Exchange end	135 ohms
MKSB and MKSA 1 x 4 x 1.2 cables from the:	
Line end	160 ohms
Exchange end	135 ohms
The crosstalk attenuation between cable pairs at the same level in a frequency range of 12 - 252 KHz	no less than 10.5 Np
The same [as above], between cable pairs at different levels	no less than 14.5 Np
The working attenuation of the phantom circuit channel (two VKO's) at frequencies of:	
0.3 KHz	no more than 0.16 Np
7 KHz	no more than 0.20 Np
The nominal value of the input impedance of the phantom circuit, from the:	
Line end	200 ohms
Exchange end	600 ohms

Equipment Complement: The VKS-OUP with 135:145 line transformers and the VKS-OUP with 135:160 transformers; the VKS-OP with 135:145 line transformers and the VKS-OP with 135:160 transformers.

Equipment	VKS-OUP No. of Units	VKS-OP No. of Units
Rack frame	1	1
Panel of input terminal blocks	1	1
VKO panel	4	2
ZU [protective filter unit] panel	4	2

Note: On twin cable trunks with a single quad cable, one VKS-OUP rack is installed at an OUP, and one VKS-OP rack is installed at an OP [terminal station]. When two trunks are present at an OP, the VKS-OUP rack can be employed.

Construction: The racks are made in the form of a frame of steel channels, on which the VKO panels are mounted without insulation, as well as the ZU panels (each having two ZU's) and the panel of input terminal blocks. There are two terminals (insulated and uninsulated) in the rack for the connection of ground wires. The overall rack dimensions are 2,600 x 650 x 250 mm.

Climatic Operational Conditions: At temperatures of from +5 to +40° C, and a relative ambient air humidity of up to 85%.

Weight: 300 kg (one rack)

Cost: VKS 1 x 4 OP 900 rubles
VKS 1 x 4 OUP 1,260 rubles.

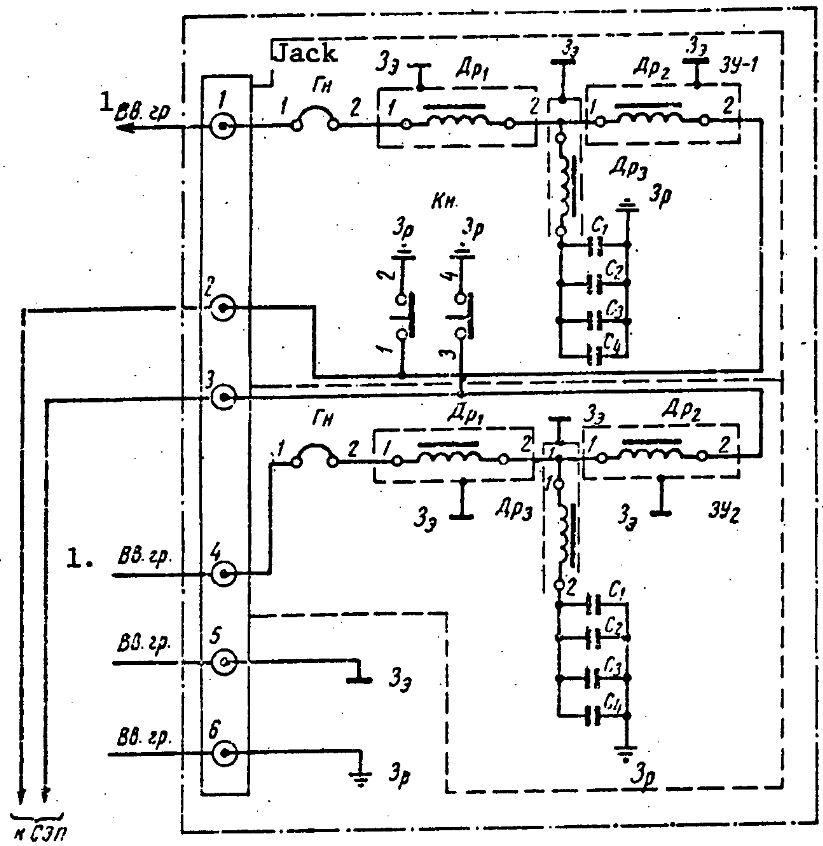


Figure 1.15.1. Basic schematic of the ZU [protective filter unit] panel of the VKS rack for 1 x 4 cable.

Key: 1. Input terminal block;

$З_Э$ = Shield ground;

Др = Choke;

$З_Р$ = Frame ground.

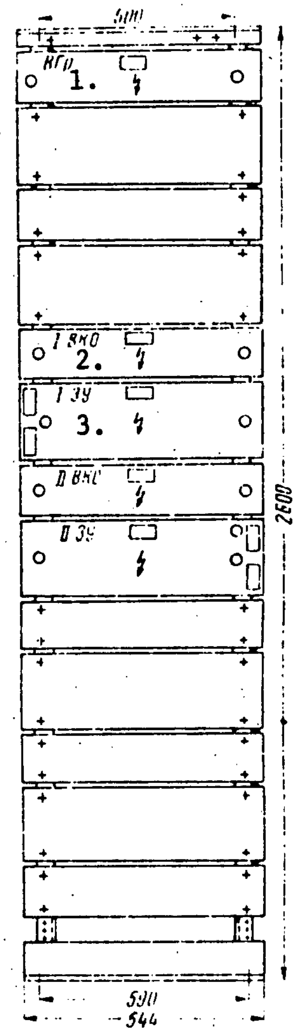


Figure 1.15.2. The placement of the equipment components in the VKS-OP cable input rack for 1 x 4 cable.

Key: 1. Input terminal blocks;
2. I VKO [cable entrance equipment unit I];
3. I ZU [protective filter unit I].

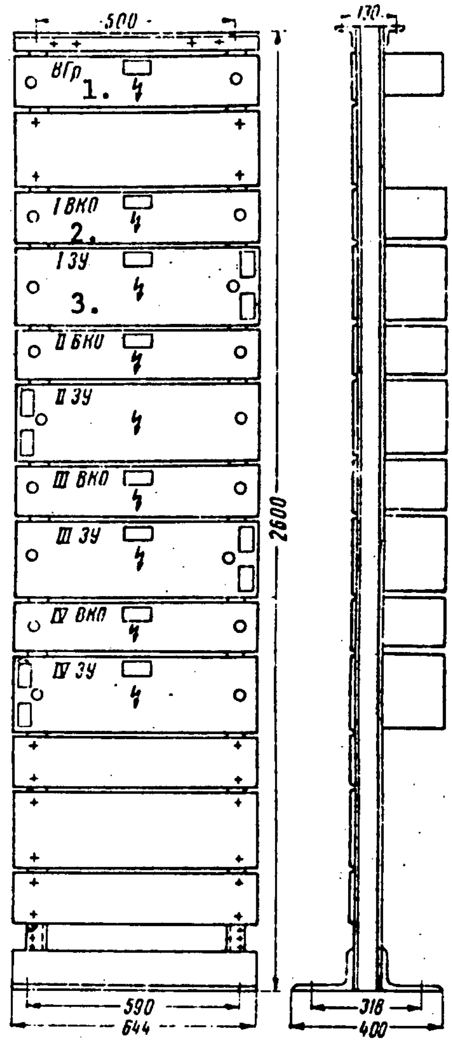


Figure 1.15.3. The placement of the equipment components in the VKS-OUP cable input rack for 1 x 4 cable.

Key: 1. Input terminal blocks;
2. I VKO;
3. I ZU.

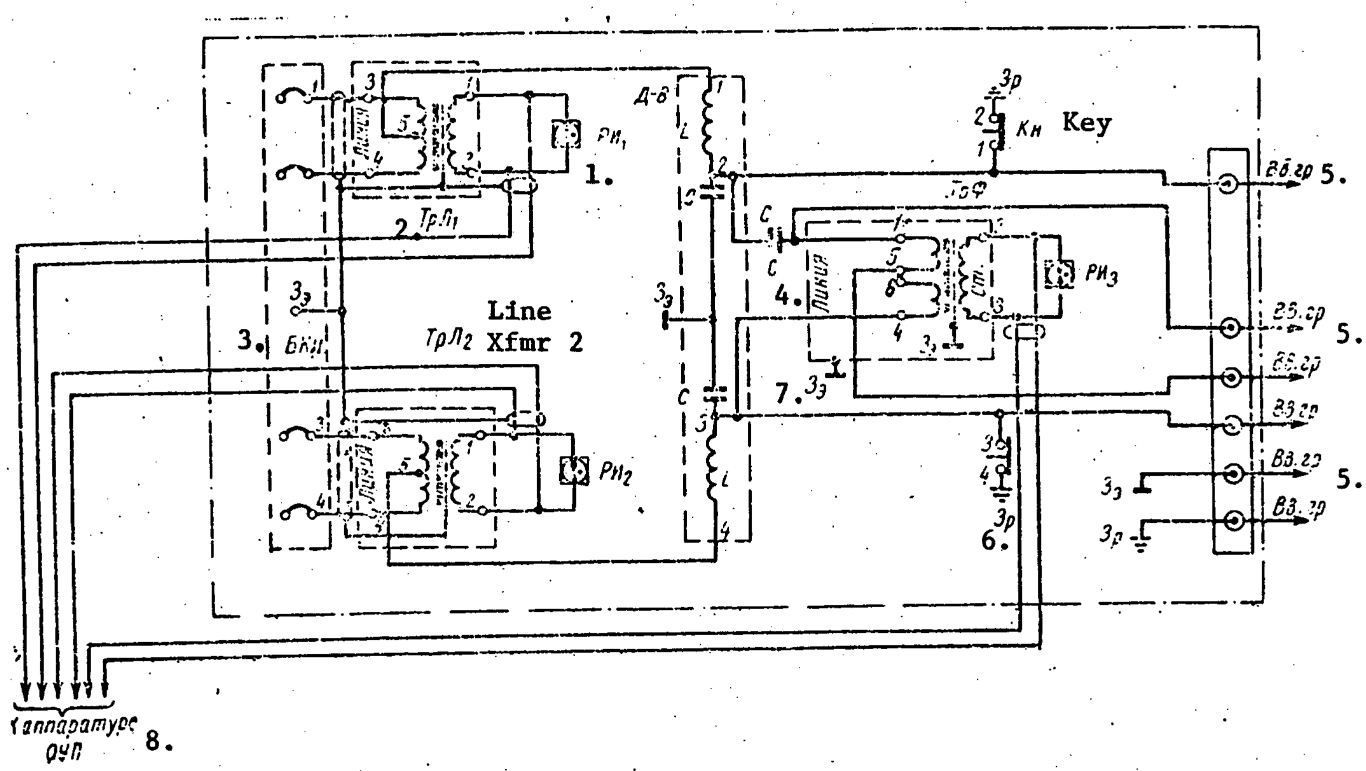


Figure 1.15.4. Main schematic of the VKO panel of the VKS rack for 1 x 4 cable.

Key: 1. RI_1 [?pulse discharger 1?];
2. Line transformer 1;
3. BKn [expansion unknown];
4. Line;
5. Input terminal block;
6. Frame ground;
7. Shield ground;
8. To attended repeater station equipment.

SECTION II Low Frequency Amplifier Equipment

2.1. The UTCh Voice Frequency Amplifier

Figures 2.1.1, 2.1.2.

Purpose: Intended for the amplification of voice frequencies, transmitted via four-wire channels, organized on phantom or physical circuits of balanced MKB or MKSB cables with a core diameter of 1.2 mm.

The UTCh can be employed for the organization of service or commercial communications, and is installed in the SPUN racks in unattended repeater stations of the vacuum tube type K-24-2 or K-60 high frequency systems.

Electrical Characteristics:

Effectively transmitted passband	300 - 3,400 Hz
Gain Control	Manual; flat within limits of 0.2 Np, in steps of 0.1 Np by means of a 0.5 Np potentiometer (continuous control) and 0.5 and 1.0 Np (coarse control); flat-sloped control in the feedback circuit by means of a correcting network in steps of 0.2 Np each.
The maximum gain at a frequency of 800 Hz	2.1 Np
The maximum relative level (with respect to power) at the amplifier output	+1.0 Np
The internal noise level of the amplifier at the +1.0 Np point	0.3 mv psophometric
The input and output impedance	600 ohms
Isolation between amplifiers in both transmit directions at 3,400 Hz	no less than 8.5 Np.

Climatic operational conditions: The amplifiers should operate at a temperature of from +5 to +35° C, and a relative ambient air humidity of 85%.

Electrical power supply: Local or remote supply in conjunction with transmission systems using a "wire--wire" or "wire--ground" circuit. The voltage is 24 volts ± 10% (the UTCh is transistorized).

The type of semiconductor devices: The P14 transistor.

Construction: Two amplifiers are housed on one board. The board dimensions are 88 x 645 x 250 mm. The hookup wires are brought in to two connectors, located at the right side. Where necessary, the 16 contact connectors can be circumvented, and the rack wiring can be connected through seals directly to the connectors of the removable amplifier blocks.

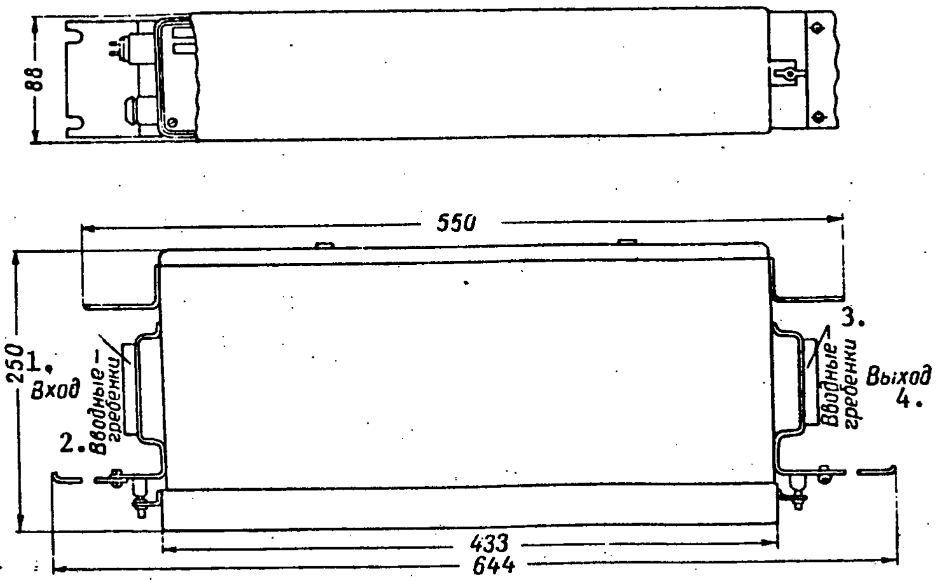


Figure 2.1.1. The construction of the UTCh voice frequency amplifier.

Key: 1. Input;
2. Input terminal blocks;
3. Input terminal blocks;
4. Output.

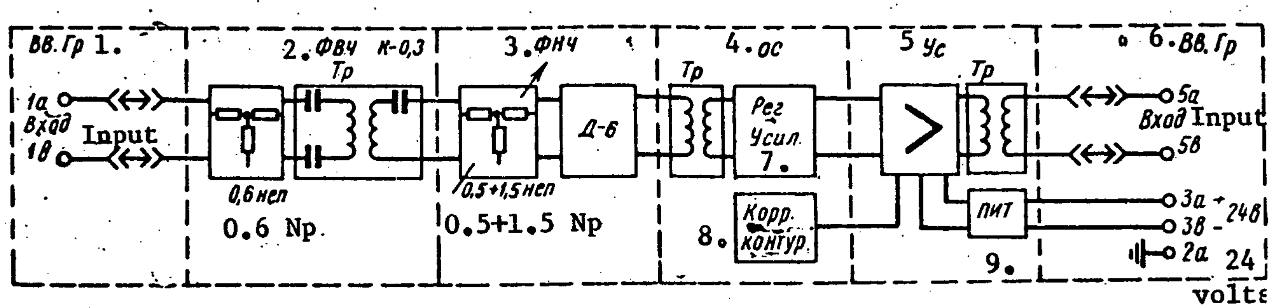


Figure 2.1.2. Block diagram of the UTCh voice frequency amplifier.

Key:
1. Input terminal block;
2. High pass filter;
3. Low pass filter;
4. OS [?terminal station?];
5. Amplifier;
6. Input terminal block;
7. Gain control;
8. Correcting network;
9. Power supply unit.

Weight: 7 Kg; Cost: 114 rubles

2.2. The SUTU and SUTU-S Universal Voice Frequency Amplifier Racks

(Taken out of production) Figures 2.2.1. - 2.2.3.

Purpose: Intended for use on open wire steel circuits and nonferrous metal circuits (copper, bimetal), on the physical circuits of non-coil-loaded cables, and on the physical and phantom circuits of coil-loaded cables. The amplifiers can be used as the terminal or intermediate amplifiers on both two-wire and four-wire circuits, as well as for making a transition from two-wire to four-wire circuits.

The SUTU and SUTU-S amplifiers are similar as regards their electrical parameters and differ only in the nature of the electrical power supply.

Electrical Characteristics:

Effectively transmitted passband for the case of:

A two-wire circuit:	
Steel circuits	300 - 2,000 Hz
Copper and bimetal circuits	300 - 2,400 Hz
Non-coil-loaded cable with 1.2 mm diameter cores; physical and phantom circuits of a coil-loaded cable with 1.2 mm diameter cores and the physical and phantom circuits of a coil-loaded cable with 0.9 mm diameter cores	300 - 2,600 Hz
A four-wire circuit:	
Non-coil-loaded cable with 1.2 mm diameter cores	300 - 2,600 Hz
Coil-loaded cable with 1.2 mm diameter cores	300 - 3,400 Hz

Gain control: manual, with a range of 2.2 Np in steps of 0.1 Np each.

Amplifier gain at 800 Hz for the case of:	Maximum Np	Permissible Np
A two-wire circuit:		
Steel circuits	1.6	1.4
Copper and bimetal circuits	2.6	1.6.
Coil-loaded cable with 0.9 and 1.2 mm diameter cores	2.3	2.3
Non-coil-loaded cable with 1.2 mm diameter cores	2.0	2.0

Note: The least permissible gain is determined by communications stability requirements.

A four-wire circuit:	
Non-coil loaded cable with 1.2 mm diameter cores	2.8 nep

Coil-loaded cable with 1.2 mm diameter cores	3.0 Np
Coil-loaded cable with 0.9 mm diameter cores	3.1 Np

Nominal relative transmit level at the amplifier output	0.0 - +0.6 Np
Residual channel attenuation	0.8 Np
Magnitude of the channel stability	0.2 Np
Length of repeater sections which can be equalized (without taking into account the amplitude-frequency distortions due to mismatching):	
Steel circuits	40 - 80 km
Copper circuits	200 - 400 km
Bimetal circuits	150 - 250 km
Non-coil-loaded cable with 1.2 mm diameter cores	25 - 46 km
Coil-loaded cable with 0.9 and 1.2 mm diameter cores	80 - 170 km
The input and output impedance of the equipment	600 ohms
The reflection factor with respect to 600 ohms at the:	
Line end:	
For a two-wire circuit	0.25
For a four-wire circuit	0.4
Exchange end:	0.1
The nonlinear distortion factor when loaded into 600 ohms (an output level of +1.5 Np)	3%

Electrical Power Supply:

Voltages:	SUTU-8 (or 4)	SUTU-S
Plate	206 $\pm$ 3% or 220 $\pm$ 10% V.	127/220 volts AC (there is the option of a DC power supply)
Filament and signaling	24 $\pm$ 10% or 21.2 $\pm$ 3% V.	
Current or power consumption:		
Plate	0.14 amps	150 watts
Filament	0.8 amps	
Signaling	0.2 amps	
Type of vacuum tubes employed:	10Zh1L	

Equipment Complement: The SUTU-8, with 8 amplifiers
The SUTU-4, with 4 amplifiers
The SUTU-S, with 6 amplifiers.

Housed in the racks are the following:

	SUTU-8 (or 4)	SUTU-S
Amplifiers with the gain control and equalizers	8 or 4	6
Sets of relays for ring repeating	16	12
The intercom-callup unit board	1	1
Neper meter	1	1
Balancing transformers	16	12
Jackfield panel	1	1
Balancing networks	16	12
Power supply unit	-	2
Control panel	1	1
Panel of input terminal blocks	1	1

Construction: Rack filled on both sides. The overall rack dimensions are 2,500 x 648 x 410 mm.

Weight:

Стойка Rack	Вес, кг Weight, kg
SUTU-8 СУТУ-8	380
SUTU-4 СУТУ-4	300
SUTU-S СУТУ-С	350

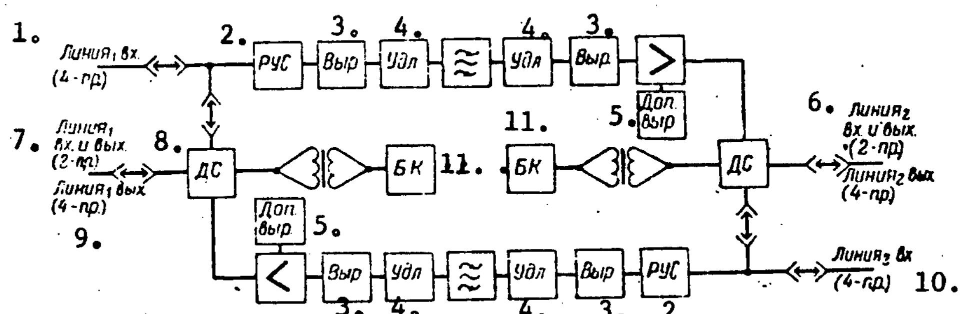


Рис. II.2.1. Блок-схема универсального тонального усилителя стойки СУТУ (без указания вызывных цепей)

Figure 2.2.1. Block diagram of the SUTU universal voice frequency amplifier rack (the ringing circuits are not shown).

Key:
1. Line 1 input (four-wire);
2. RUS [expansion unknown];
3. Equalizer;
4. Attenuator pad;
5. Supplemental equalizer;
6. Line 2 input and output (two-wire); line 2 output (four-wire);
7. Line 1 input and output (two-wire);
8. Differential system;
9. Line 1 output (four-wire);
10. Line 2 input (four-wire);
11. BK [balancing network].

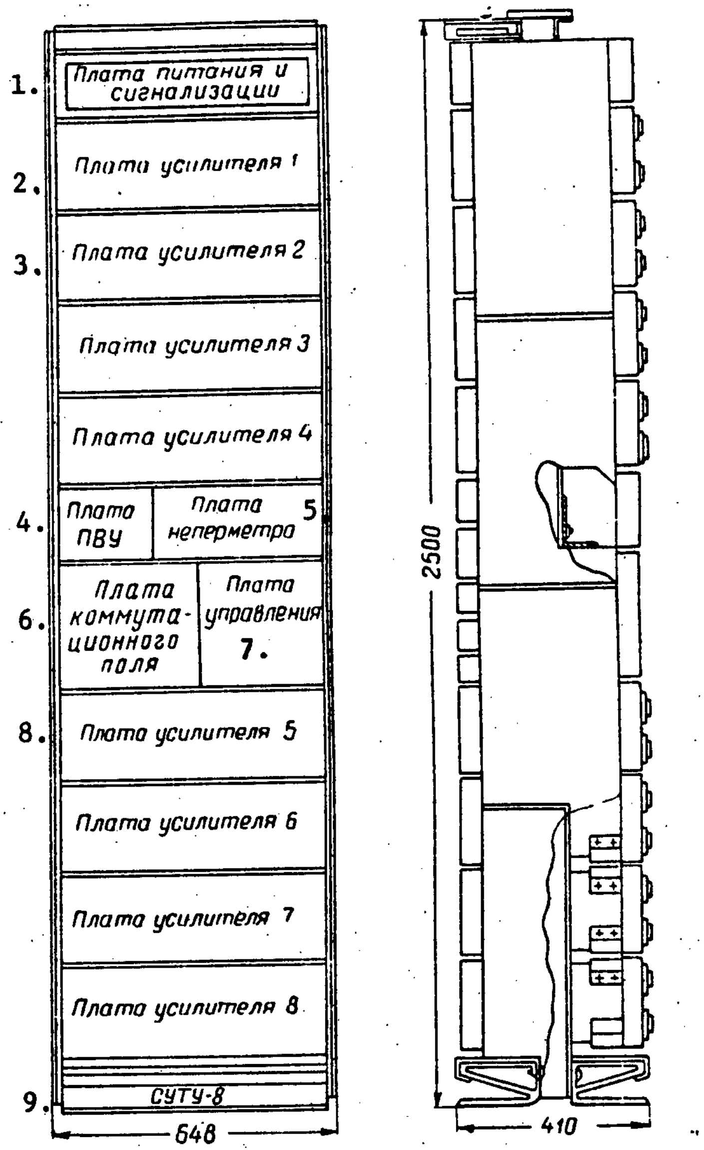


Рис. II.2.2. Размещение оборудования на стойке универсальных тональных усилителей СУТУ-8

Figure 2.2.2. The placement of the equipment in the SUTU-8 universal voice frequency amplifier rack.

Key: 1. Power supply and signaling panel;
2. Amplifier 1 panel;
3. Amplifier 2 panel;
4. Intercom-callup unit panel;
5. Neper meter panel
6. Jackfield panel;
7. Control panel;
8. Amplifier 5 panel;
9. SUTU-8.

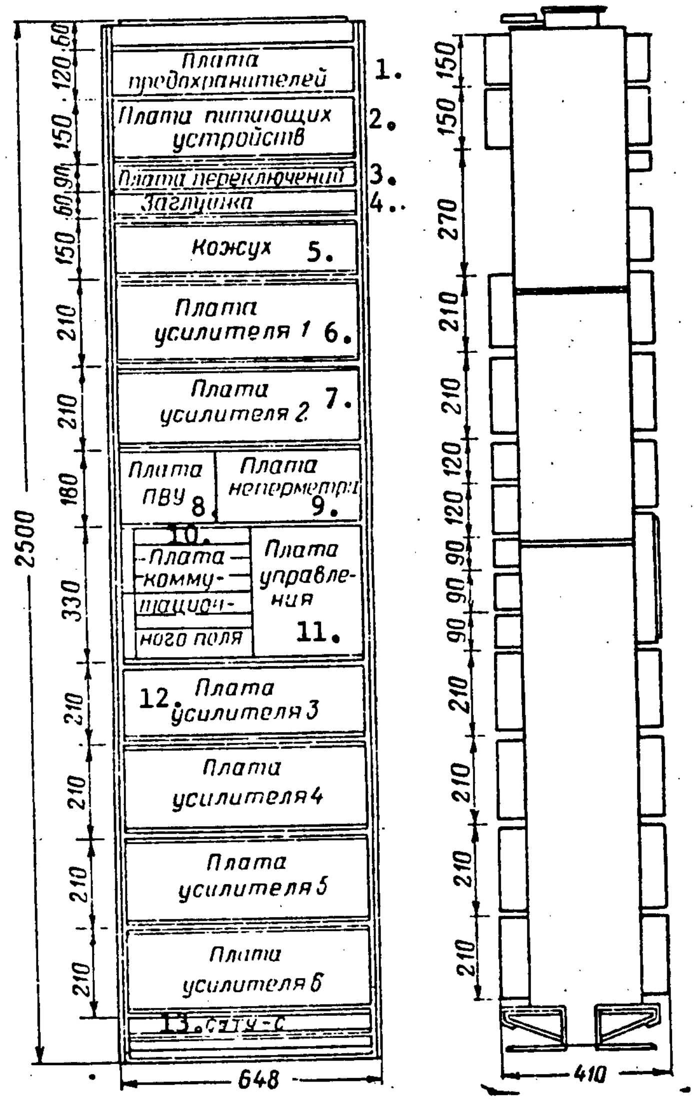


Рис. II.2.3. Размещение оборудования на стойке универсальных тональных усилителей СУТУ-С

Figure 2.2.3. The placement of the equipment in the SUTU-S universal voice frequency amplifier rack.

Key:
1. Panel of fuses;
2. Panel of power supply units;
3. Switching panel;
4. Blank panel;
5. Housing;
6. Amplifier 1 panel;
7. Amplifier 2 panel;
8. Intercom-callup unit panel;
9. Neper meter panel;
10. Jackfield panel;
11. Control panel;
12. Amplifier 3 panel
13. SUTU-S.

2.3. The STY-4SM, STU-4K, ITUM 1-7 and TU 1-4 Voice Frequency Amplifier Equipment

Figures 2.3.1 - 2.3.7.

Purpose: Intended for the organization of voice frequency channels on open wire steel circuits, on nonferrous metal circuits (copper, bimetal), on coil-loaded and non-coil-loaded cable circuits with cord-paper and cord-styroflex insulation, and on PRPPM cable.

The amplifiers can be used as two-wire or four-wire intermediate or terminal amplifiers, as well as transition amplifiers going from two-wire to four wire circuits.

Electrical Characteristics:

The effectively transmitted passband for the following circuits:

Steel	300 - 2,000 Hz
Copper and bimetal open wire	300 - 2,400 Hz
Cable with 0.9 mm diameter cores and PRPPM cable	300 - 2,400 Hz
Four-wire, non-coil-loaded cable circuits, with a diameter of 1.2 mm	300 - 3,400 Hz

Gain control — manual, with a range of 2.2 Np, in steps of 0.1 Np each.

Gain of an amplifier used as an intermediate amplifier, at 800 Hz, when the line transformers are connected as follows:

Two-wire connection	Maximum Np	Permissible Np
Steel circuits	1.6	1.4
Copper circuits	2.0	1.6
Bimetal circuits	2.0	1.6

Note: The least permissible gain is determined by the requisite communications stability.

1.2 mm PRPPM cable	2.0
Non-coil-loaded cable with 0.9 mm diameter cores	1.9
Coil-loaded cable with 0.9 mm diameter cores	2.3

Four-wire connection:

Non-coil-loaded cable with 1.2 mm and 0.9 mm diameter cores	2.8

The nominal relative amplifier level for a load of 600 ohms:

Four-wire connection	+1 Np
Two-wire connection	+0.6 Np

The repeater section length which can be equalized (without taking into account the amplitude-frequency distortion due to mismatching):

4 mm steel circuits	10 - 80 km
4/0.4 mm bimetal circuits	150 - 250 km
1.2 mm type PRPPM non-coil-loaded cable lines with polyvinylchloride insulation	2.5 - 16.5 km
Physical and phantom circuits of 1.2 mm cable lines with cord-styroflex insulation	12 - 50 km
Physical and phantom circuits of 1.2 mm cable lines with cord-paper insulation	12 - 45 km
3-4 mm copper circuits	200 - 400 km
0.9 mm non-coil-loaded cable lines	22 - 35 km
0.9 mm coil-loaded cable lines	up to 120 km

Input and output impedence	600 ohms
Isolation at a frequency of 800 Hz:	
Between two simplex amplifiers, mounted on the same base	no less than 7 Np
Between any two amplifiers located in a rack on different bases	no less than 9 Np
Noise voltage at the amplifier output	0.3 mv psophometric (taking into account voice frequency ring signal residues, no more than 1 mv psophometric)

The ringing system:

Magnetoringing	15 - 50 Hz
Voice frequency ringing, for:	
steel circuits	1,900 Hz
copper, bimetal and cable circuits	2,100 Hz

Note: A provision is made on 4-wire cable circuits for the reception and transmission of voice frequency dial pulses at a frequency of 2,100 Hz.

Climatic operational conditions:

The amplifier should operate at a temperature of from -5 to +35°C, and a relative ambient air humidity of 85%.

The electrical power supply:

Voltages:

for regulated current sources	20.6 - 21.8 v
for non-regulated current sources (nominal voltage, 24 v)	22 - 26.4 v

A provision is made for the capability of powering amplifiers remotely in conjunction with HF equipment and using separate remote power supply units.

Current consumption for individual types of voice frequency amplifiers at a voltage of 24 v:

CTU-4SM, STU-4K	0.252 amps over a 24-hour day, 0.08 amps for 1 hour in a 24 hour day (intercom-call up unit, etc.);
ITUM-1, ITUM-5, ITUM-6	0.02 amps in the course of a 24-hour day
ITUM-2, ITUM-3, ITUM-4, ITUM-7	0.063 amps in the course of a 24-hour day, and 0.08 amps for 1 hour in a 24-hour day (intercom-call up unit, etc.).

Type of semiconductor devices:

Junction transistors of the P13A, P13B and P202 types.

Equipment complement:

STU-4SM. A rack of voice frequency amplifiers consisting of four 2-wire amplifiers for steel and copper open wire circuits, and contains:
--four 2-wire amplifiers, containing differential systems, balance networks, gain controls, filters, equalizers for copper and steel open wire circuits, amplifier elements, ring and dial devices, and the common rack unit for 10 amplifiers;
--eight line transformers, selected in pairs with the balancing transformers;
--the P-321 measurement instrument;
--variable balancing line.

STU-4K. A rack of voice frequency amplifiers consisting of four 4-wire amplifiers for non-coil-loaded cable circuits with 1.2 mm diameter cores, and containing:
--four terminal 4-wire amplifiers, containing panels with jacks, differential systems, balancing networks, filters, equalizers for cable circuits with 1.2 mm diameter cores, amplifier elements, ring and dial devices, and the common rack unit for 10 amplifiers;
--P-321 measurement instrument.

ITUM-1. The individual voice frequency 4-wire intermediate amplifier for cable with 1.2 mm diameter cores is put together with an amplifier panel, which contains disconnect jacks, gain controls, filters, equalizers for cable circuits with 1.2 mm diameter cores and amplifier elements.

ITUM-2. Individual voice frequency 2-wire amplifier for copper and steel circuits, contains the following:
- --panel of amplifiers with differential systems, balancing networks, gain controls, filters, equalizers for copper and steel circuits and amplifier elements;
- --panels of common and ring units, which contain dial and ring devices, an 800 Hz measurement generator, level meter, and components of power supply, signaling and intercom-call up unit circuits;
- --two line transformers, selected in pairs with the balancing transformers.

ITUM-3. Individual voice frequency 2-wire amplifier for bimetal open-wire circuits and PRPPM cable, contains the following:
- --a panel of amplifiers with differential systems, balancing networks, gain controls, filters, equalizers for open-wire bimetal circuits and PRPPM cable, as well as amplifier elements;
- --panels of common and ring-up devices;
- --two line transformers, selected in pairs with the balancing transformers.

ITUM-4. Individual voice frequency 4-wire terminal amplifier for non-coil-loaded cable circuits with 1.2 mm diameter cores, contains the following:
- --a panel of amplifiers with disconnect jacks, a differential system, balancing network, gain controls, filters, equalizers for cable circuits with 1.2 mm diameter cores as well as with amplifier elements;
- --panels of common and ring-up devices.

ITUM-5. Individual voice frequency 4-wire intermediate amplifier for non-coil-loaded cable circuits with 0.9 mm diameter cores, makes up a set with the amplifier panel, which contains the disconnect jacks, gain controls, filters, equalizers for cable circuits with 0.9 mm diameter cores and amplifier elements.

ITUM-6. Individual voice frequency 2-wire terminal amplifier for coil-loaded cable circuits with 0.9 mm diameter cores, contains the following:
- --panel of amplifiers with disconnect jacks, differential system, balancing network, gain control, filters, equalizers for cable circuits with 0.9 mm diameter cores and amplifier elements;
- --line transformer.

ITUM-7. Individual voice frequency 2-wire amplifer for coil-loaded and non-coil-loaded cable circuits with 0.9 mm diameter cores, contains the following:
- --panel of amplifiers with differential systems, balancing networks, gain controls, filters, equalizers for cable circuits with 0.9 mm diameter cores and amplifier elements;
- --panels of common and ring-up devices;
- --two line transformers.

Voice frequency amplifiers to complete the equipment package of the STU-4SM and STU-4K:

TU-1. Put together from a set of ITUM-1 blocks.

TU-2. Put together from a set of blocks for two ITUM-2 amplifiers and four transformers (installed separately).

TU-3. Put together from a set of blocks of two ITUM-3 amplifiers and four line transformers (installed separately).

TU-4. Put together from a set of blocks of two ITUM-4 amplifiers.

Construction:

STU-4SM, STU-4K. The racks are built on a lightweight frame of steel sections, where the frame is formed with facing cabinet sheets without the front wall. Mounted from the front are the base plates for supporting the blocks. The electrical connection of the blocks to the base plate is made with plug connectors. The overall rack dimensions are 2,600 x 650 x 250 mm.

ITUM-1--7 amplifiers. Mounted in metal housings, inside which the base plates are secured. The individual blocks are inserted in the base trays. It is permissible to install amplifiers in racks of the old construction or secure them to the wall by means of the brackets in the spare parts set for the ITUM-2, ITUM-3 and ITUM-4. (For the case of fastening to a wall, it is necessary to provide for a spacing of 40-50 mm from the wall to bring in the cables to an amplifier.)

Dimensions of the amplifiers:

--ITUM-1, ITUM-5 and ITUM-6: one panel 150 x 644 x 250 mm (with the protruding parts);

--ITUM-2, ITUM-3, ITUM-4 and ITUM-7: two panels, 300 x 644 x 250 mm (with the protruding parts);

--TY-1--4 are installed in the STU racks and have the following dimensions:

--TU-1: one rack panel, 150 x 650 x 250 mm;

--TU-2, TU-3 and TU-4: for each type, three rack panels for each two amplifiers for two transmit directions: 450 x 650 x 250 mm.

At the present time, industry is producing the type 5Ya71 universal voice frequency amplifier, intended for the organization of a telephone channel in a frequency range of 300-3,400 Hz on the physical and phantom circuits of non-coil-loaded and coil-loaded cables with cord-paper and cord-styroflex insulation with core diameters of 0.9 mm and 1.2 mm. The amplifier is used as a 4-wire intermediate amplifier, as well as a 4-wire terminal amplifier with 2- and 4-wire outputs to the switchboard.

The amplifier replaces the ITUM-1, 4, 5, 6 and 7.
Dimensions: 152 x 640 x 320 mm (in its package).

ВЕС И СТОИМОСТЬ WEIGHT AND COST

Стойка, усилитель Rack, Amplifier		Вес, кг Weight, kg	Цена, руб. Price, rubles
СТУ-4СМ	STU-4SM	156	2266
СТУ-4К	STU-4K	140	2117
ИТУМ-1	ITUM-1	15	214
ИТУМ-2	ITUM-2	30	449
ИТУМ-3	ITUM-3	30	449
ИТУМ-4	ITUM-4	30	422
ИТУМ-5		15	214
ИТУМ-6		15	306
ИТУМ-7	ITUM-7	30	448
ТУ-1	TU-1	10	198
ТУ-2	TU-2	30	783
ТУ-3	TU-3	30	783
ТУ-4		28	736
5Я71	5Ya71	18	1680

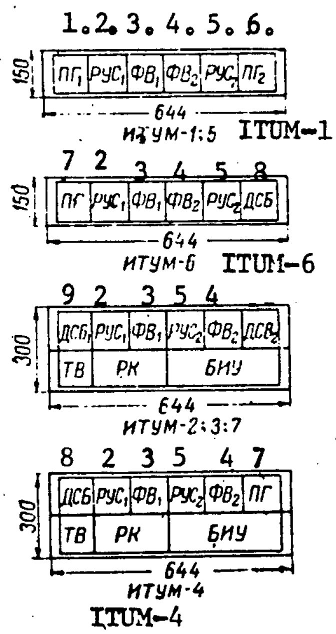


Рис. 6.

Figure 2.3.1. The arrangement of the blocks of ITUM-1 -- 7 amplifiers.

Key:
1. PG_1 [expansion unknown];
2. RUS_1 [?level control 1?];
3. FV_1 [?filter-equalizer 1?];
4. FV_2 [?filter-equalizer 2?];
5. RUS_2 [?level control 2?];
6. PG_2 [expansion unknown];
7. PG [expansion unknown];
8. DSB [?differential system-balancing network?];
9. DSB_1 [?differential system-balancing network 1?].

ТВ, РН, БИУ [unknown]

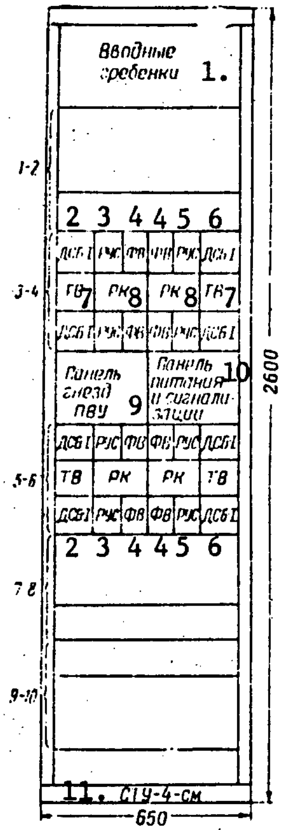


Рис. II.3.2. Размещение оборудования на стойке тональных усилителей СТУ-4СМ

Figure 2.3.2. The placement of the equipment in the STU-4SM voice frequency amplifier rack.

Key:
1. Input terminal blocks;
2. DSB-1 [?differential system-balancing network 1?];
3. RUS [?level control?];
4. FV [?filter-equalizer?];
5. RUS;
6. DSB-1;
7. TV [expansion unknown];
8. RK [expansion unknown];
9. intercom-call up unit and jack panel;
10. power supply and signaling panel;
11. STU-4SM.

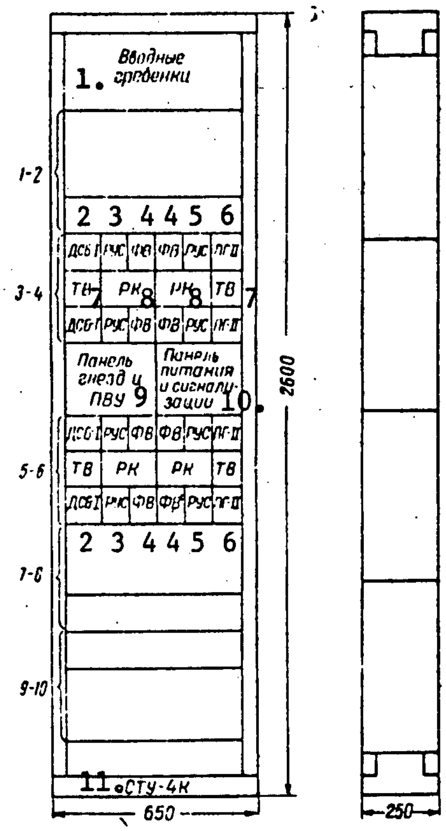


Рис. II.3.3. Размещение оборудования на стойке тональных усилителей СТУ-4К

Figure 2.3.3. The placement of the equipment in the STU-4K voice frequency amplifier rack.

Key: 1. Input terminal blocks;
2. DSB-1 [?differential system-balancing network 1?];
3. RUS [?level control?];
4. FV [?filter-equalizer?];
5. RUS;
6. PG-II [expansion unknown];
7. TV [expansion unknown];
8. RK [expansion unknown];
9. Intercom-call up unit and jack panel;
10. Power supply and signaling panel;
11. STU-4K.

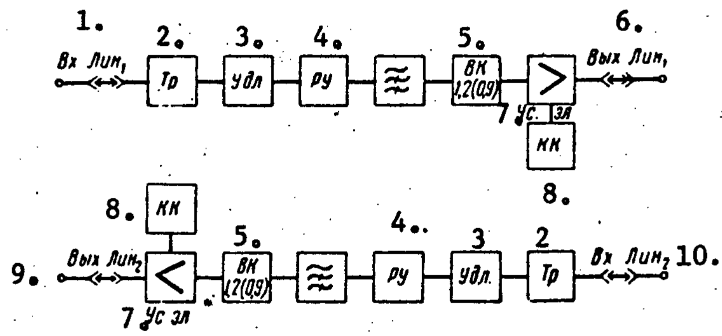


Рис. II.3.4. Блок-схема 4-проводного промежуточного усилителя ИТУМ-1, 5

Figure 2.3.4. Block diagram of the ITUM-1 and ITUM-5 4-wire intermediate amplifier.

Key:
1. line input;
2. transformer;
3. pad;
4. level control;
5. equalizing network;
6. line output;
7. amplifier element;
8. correcting network;
9. line 2 output;
10. line 2 input.

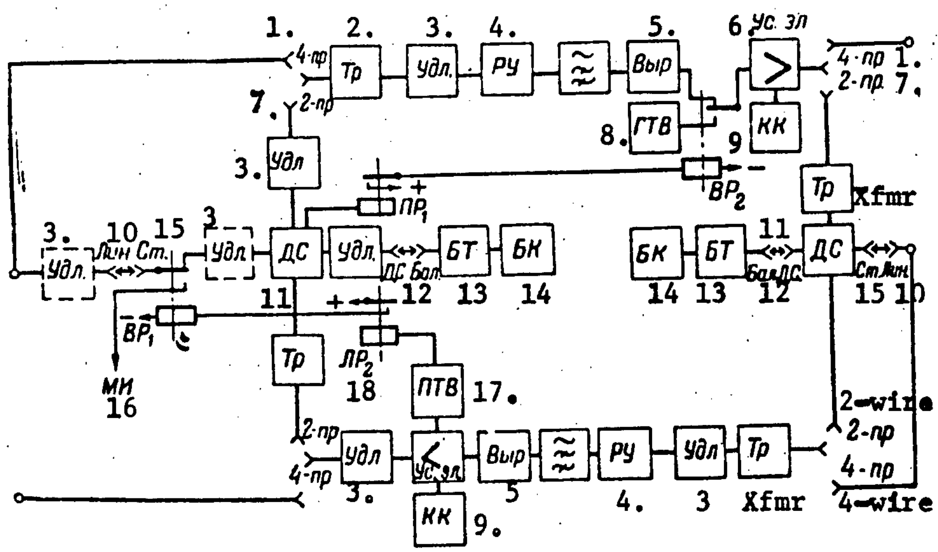


Рис. II.3.5. Блок-схема 2-проводного (оконечного, промежуточного) усилителя ИТУМ-2, 3, 7

Удлинители, показанные пунктиром, включаются при работе усилителей в режиме оконечных. Выравниватели (Выр) включаются: для ИСУМ-2—ВСМ, для ИТУМ-3—ВБ, для ИТУМ-7—В-0,9

Figure 2.3.5. Block diagram of the ITUM-2, 3 and 7 2-wire (terminal, intermediate) amplifiers.

The pads indicated with the dashed line are inserted when the amplifiers work as terminal amplifiers. The equalizers (Выр) include the following: for the ISUM-2 [sic], VSM; for the ITUM-3, VB; and for the ITUM-7, V-0.9.

Key:
1. 4-wire;
2. transformer;
3. pad;
4. level control;
5. equalizer;
6. amplifier element;
7. 2-wire;
8. voice frequency ring generator;
9. correcting network;
10. line;
11. differential system;
12. differential system to balancing networks;
13. balancing transformer;
14. balancing network;
15. exchange;
16. MI [expansion unknown];
17. PTV [expansion unknown, possibly a voice frequency ringing device?];
18. LR_2 [?line relay 2?].

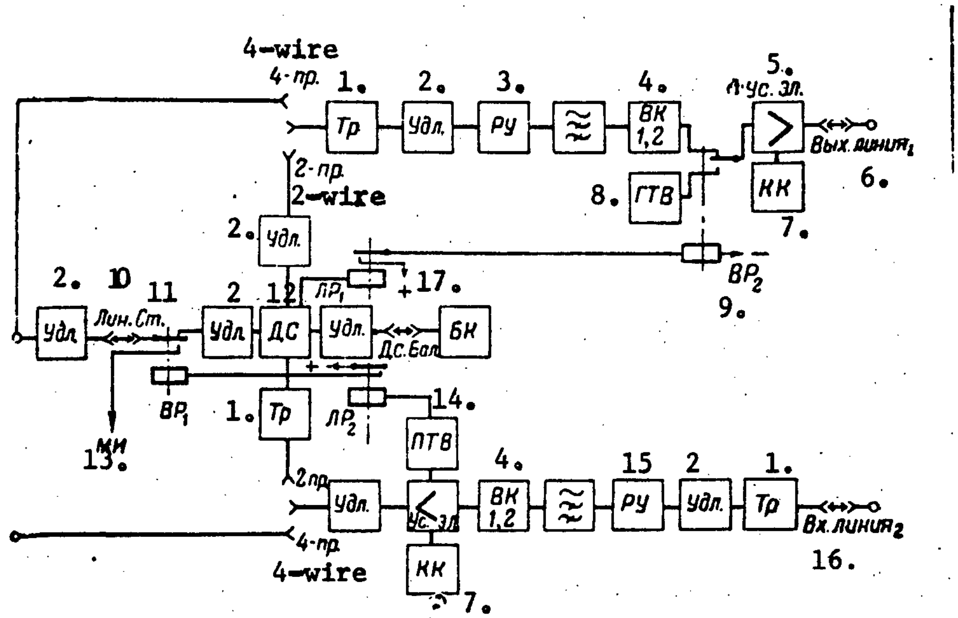


Рис. II.3.6 Блок-схема 4-проводного оконечного усилителя ИТУМ-4

Figure 2.3.6. Block diagram of the ITUM-4 4-wire terminal amplifier.

Key:
1. transformer;
2. pad;
3. level control;
4. equalizing network;
5. amplifier element;
6. line 1 output;
7. correcting network;
8. voice frequency ring generator;
9. VR_2 [expansion unknown];
10. line;
11. exchange;
12. differential system;
13. MI [expansion unknown];
14. PTV [expansion unknown];
15. level control;
16. line 2 input;
17. LR_1 [?line relay 1?].

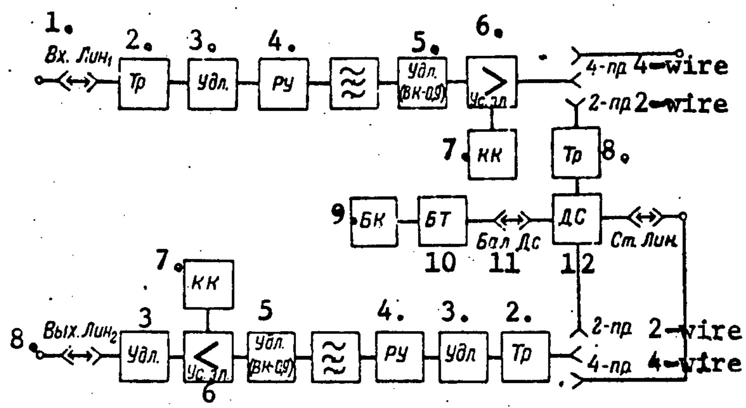


Рис. II.3.7 Блок-схема 2-проводного оконечного усилителя с 4-проводным окончанием со станционной стороны ИТУМ-6

Figure 2.3.7. Block diagram of the ITUM-6 2-wire terminal amplifier with 4-wire termination at the exchange end.

Key:
1. line 1 input;
2. transformer;
3. pad;
4. level control;
5. pad (VK-0.9) [equalizing network-0.9];
6. amplifier element;
7. correcting network;
8. transformer;
9. balancing network;
10. balancing transformer;
11. balancing networks to differential system;
12. differential system.

SECTION III Transmission Systems Using Open Wire Communications Lines

3.1. The V-2 Two Channel Transmission System

Figures 3.1.1, 3.1.2.

Purpose: Intended for the organization of junction lines between rural automatic telephone exchanges and manually serviced telephone exchanges by means of multiplexing short, open wire steel circuits with two HF channels (while retaining a voice frequency channel on the multiplexed circuit). The equipment does not provide for intermediate amplifiers. The equipment is designed for joint operation via parallel circuits multiplexed with other systems.

Being produced at the present time is the modernized V-2-2 equipment, which permits covering greater distances, because of the application of intermediate amplifiers and AGC. The design principles, line frequency spectra and transmit levels are similar to that for the V-2 equipment.

Type of line used:

Open wire steel circuits with a diameter of 3-4 mm.

Communications system:

Two band. The equipment is designed using the group principle with the transmission of one side band into the line.

Electrical characteristics:

The line frequency spectrum:	
A-B direction	4.63 - 12.7 kHz
B-A direction	17.63 - 25.7 kHz
Number of channels which can be organized	2 HF channels
The effectively transmitted band width of the channels	300 - 3,400 Hz
Maximum communications range	32 km (see the table)

Wire Diameter Диаметр проводов мм mm	Spacing between the wires, cm Расстояние между проводами, см	Дальность связи, км Service Range, km	
		максимальная Maximum	минимальная Minimum
3	20	22	7,5
	40	24	8,0
	60	26	8,5
4	20	27	9,0
	40	30	10
	60	32	11

[Note to preceding table]
Note: The operational range of the equipment can be doubled by means of organizing permanent 4-wire through working with levels at the switching points of 0.4 Np and repeating of the ring signals.

Maximum gain	4.9 Np at the upper frequency of 5.7 kHz
Nominal relative transmit level (with respect to power)	+0.5 ± 0.05 Np
Input impedence of the equipment from the:	
line end	800 ohms (a provision is made in the transformer of the K-3.6 filter for the capability of switching the input impedence to 180 ohms)
exchange end	600 ohms
The nominal relative voice frequency level of the channels:	
at the input to the 4-wire section of the channel	-1.5 Np
at the output of the 4-wire section of the channel	+0.5 Np
at the input and output of the 2-wire section of the channel	0.0 or -0.3 Np

Note: The sets of low frequency terminations of HF channels, which are the coupling link with the telephone exchange instruments, are connected to the 4-wire line of the channel at the points with -1.5 Np levels on transmit and +0.5 Np on receive, and provide for one of the following operational modes of a rural network (something which is agreed upon when ordering the equipment):

--The terminal operational mode of the channels with a residual attenuation of 0.8 Np, with the capability of going over to a 2-wire through working mode by means of automatically switching out the through working pads of 0.8 Np each in the transmit and receive channels at the originating end upon a signal from the RSL [line connector relay] sets (Type 1).

--A terminal operational mode of the channels with a residual attenuation of 0.8 Np with the capability of going over to the 4-wire through working mode at the switching points with levels of -0.4 Np by means of automatically cutting out the differential systems upon a signal from the RSL complexes (Type II);

--A terminal operational mode of the channels with a residual attenuation of 0.8 Np between manually serviced rural exchanges with transmission and reception of a magnetoring via two wires (Type III).

The ring up system using the HF channels, as well as the transmission and reception of the control and interaction signals (for ATS's) and the ring

signals (for manual servicing) are realized at a frequency of 4,000 Hz.

Climatic operational conditions: At a temperature of from +10 to +40°C and a relative ambient air humidity of 80%.

Electrical power supply:

voltages	24 or 60 volts
current consumption	150 ma (270 ma when the ring devices are operating)

Equipment complement:
Included in the equipment complement are two stations (A and B).
Each station contains: a HF block (of the A or B type); a set of low frequency terminations, KNO (type I, II or III); a connecting link for connecting the HF block and the KNO set.
Also provided in the equipment is a measurement device for monitoring the residual attenuation of the channels and aligning the equipment.

Construction: The station is designed in the form of an instrument which has dimensions of 412 x 310 x 231 mm. The station can be mounted on a desk or in a rack of the equipment of the LATs [line equipment shop] (using two brackets).

Weight: 30 kg (stations A and B).

Cost: 911 rubles (a set of stations A and B).

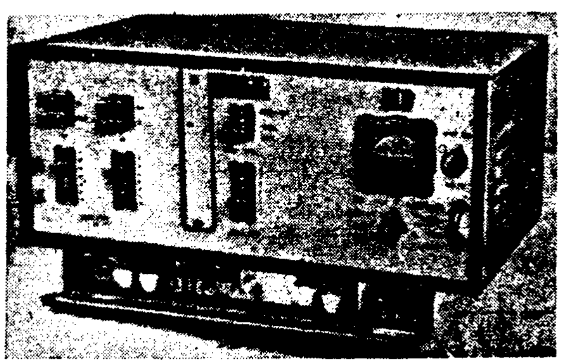


Figure 3.1.1. External view of the V-2 station.

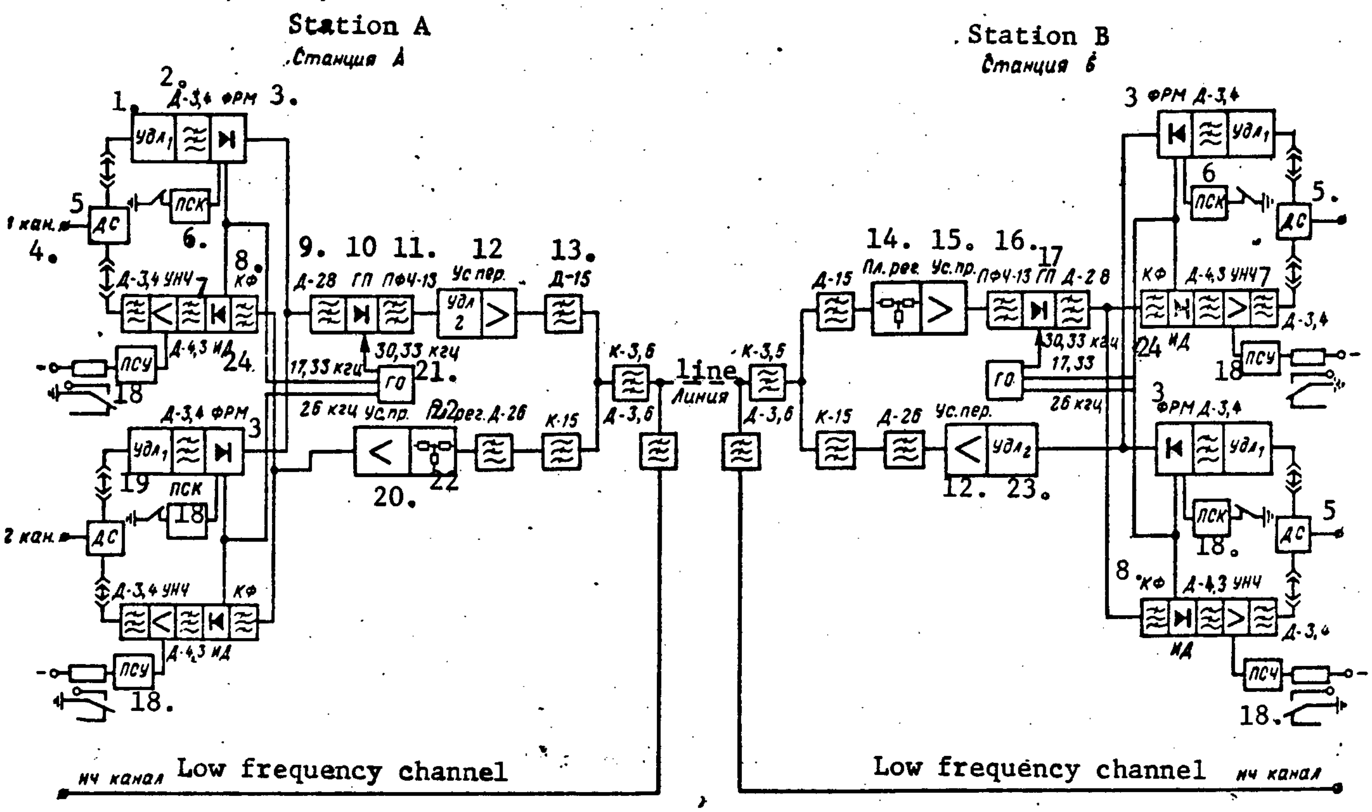


Figure 3.1.2. Block diagram of the terminal station of the V-2 transmission system.

Key:
1. attenuator pad 1;
2. D-3.4 [kHz] filter;
3. FRM [unknown type of modulator];
4. channel 1;
5. differential system;
6. PSK [expansion unknown];
7. UNCh [low frequency amplifier];
8. KF [?channel filter?];
9. D-28 filter;
10. GP [?group converter?];
11. PFCh-13 [unknown type of band pass filter];
12. transmit amplifier;
13. D-15 filter;
14. flat gain control;
15. receive amplifier;
16. PFCh-13;
17. GP [?group converter?];
18. PSU [expansion unknown];
19. Pad 1;
20. Receive amplifer;
21. GO [unknown type of signal generator];
22. flat gain control;
23. pad 2;
24. ID [unknown type of detector].

3.2. The OKS Single Channel Transmission System (taken out of production)
Figures 3.2.1, 3.2.2.

Purpose: Intended for multiplexing open wire steel circuits or circuits of a non-ferrous metal.

Type of line used: Open wire steel circuits or circuits of a non-ferrous metal having a diameter of 3-4 mm.

Communications system: Two-band, electrically 4-wire, physically 2-wire.

Electrical characteristics:

Line frequency spectrum:	
A-B direction	2.6 - 5.1 kHz
B-A direction	6.7 - 9.2 kHz
Number of channels which can be organized	2 channels (one voice frequency channel and one HF channel)
The effectively transmitted pass band of the channels:	
voice frequency	300 - 2,000 Hz
HF	300 - 2,800 Hz
The residual attenuation of the channels at 800 Hz:	
for a 4-wire circuit configuration	0.0 Np
for a 2-wire circuit configuration	0.8 Np
Length of a repeater section:	
4 mm steel for the case of "25 mm rime ice"	35 - 80 km
3 mm copper for the case of "summer-damp"	100 - 400 km
Nominal relative transmit level at the output of the terminal and intermediate stations	+2.0 Np
Gain of the stations at 9.2 kHz:	
terminal stations	6.25 Np
intermediate stations	7.0 Np
The equipment input impedence from the:	
line end	1200 ohms
station end	600 ohms
The AGC system	electrical, single frequency
The AGC control frequency:	
in the A-B direction	5.4 kHz
in the B-A direction	6.4 kHz
The design frequencies for noise determination	5.1 and 9.2 kHz

Voice frequency ringing via the HF channels 1,000 Hz

The climatic operational conditions: At a temperature of from +10 to +40°C and a relative ambient air humidity of 75%.

Electrical power supply:

Voltages:	
plate	220 volts ± 10%
filament	24 volts ± 10%
Current consumption:	
terminal station (OKS-O):	
plate	0.095 amps
filament	2.0 amps
intermediate station (OKS-P):	
plate	0.085 amps
filament	1.7 amps
Type of vacuum tubes used:	6F6; 6Zh7.

Construction: The terminal and intermediate stations are housed in racks made of steel sections with the panels mounted on both sides. The dimensions of the racks are 2,500 x 530 x 410 mm.

Equipment complement:
OKS-O: terminal station
OKS-P: intermediate station

Weight:

Equipment Оборудование	Weight Вес, кг kg
ОКС-О OKS-O	250
ОКС-П OKS-P	250

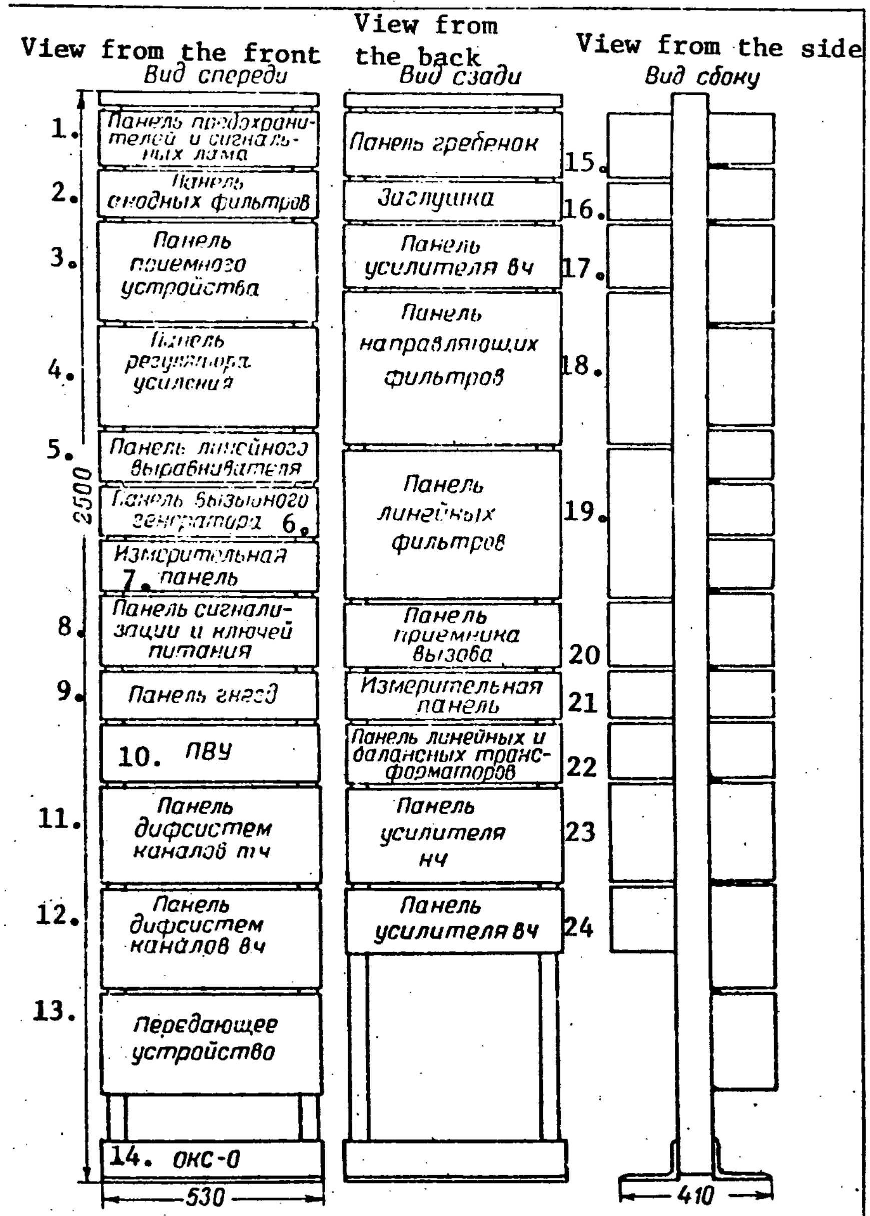


Figure 3.2.1. The placement of the equipment in the OKS-0 terminal station equipment rack.

Key:
1. panel of fuses and signal lights;
2. panel of plate filters;
3. receiving unit panel;
4. gain control panel;
5. line equalizer panel;
6. ringing generator panel;
7. metering panel;
8. signaling and power supply switch panel;
9. jack panel;
10. intercom-call up unit;
11. panel of differential systems of the voice frequency channels;
12. panel of differential systems of the HF channels;
13. transmit unit;
14. OKS-0;
15. panel of terminal blocks;
16. blank panel;
17. HF amplifier panel;
18. panel of routing filters;
19. panel of line filters;
20. ring receiver panel;
21. metering panel;
22. panel of line and balancing transformers;
23. low frequency amplifier panel;
24. HF amplifier panel.

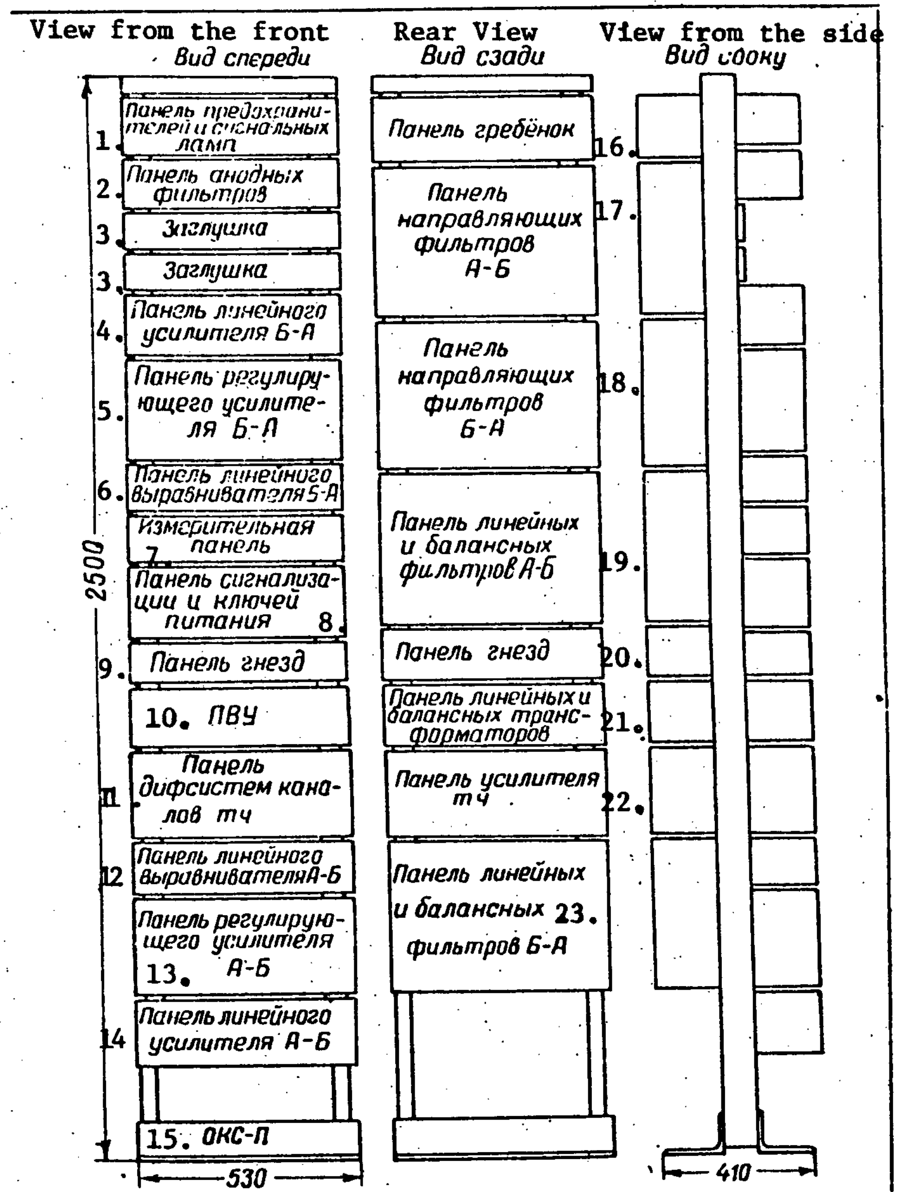


Figure 3.2.2. The placement of the equipment in the OKS-P intermediate station equipment rack.

Key:
1. Panel of fuses and signal lights;
2. Panel of plate filters;
3. Blank panel;
4. B-A line amplifier panel;
5. B-A control amplifier panel;
6. B-A line equalizer panel;
7. Metering panel;
8. Signaling and power supply switches panel;
9. Jack panel;
10. Intercom-callup unit;
11. Panel of differential systems of the voice frequency channels;
12. Panel of the A-B line equalizer;
13. Panel of the A-B control amplifier;
14. Panel of the A-B line amplifier;
15. OKS-P;
16. Panel of input terminal blocks;
17. Panel of A-B routing filters;
18. Panel of B-A routing filters;
19. Panel of A-B line and balancing filters;
20. Jack panel;
21. Panel of line and balancing transformers;
22. Voice frequency amplifier panel;
23. Panel of B-A line and balancing filters.

3.3. The VS-3 Three-Channel Transmission System (taken out of production)
Figures 3.3.1. - 3.3.4.

Purpose: Intended for multiplexing open-wire steel circuits;

Type of Line Employed: Steel circuits with diameters of 3, 4 and 5 mm.

Communications System: Two-band, electrically four-wire, physically two-wire.

Electrical Characteristics:

Line frequency spectrum:	Channel I	Channels II and III
A-B direction	6.3-8.7 KHz	10.3-15.7 KHz
B-A direction	3.3-5.7 KHz	19.3-24.7 KHz

Number of channels which can be organized	Three HF channels
The capability of secondary multiplexing of HF channels	One of the telephone channels can be used for 12 voice frequency telegraphy (TT) channels

Companders are provided in the equipment, and when they are switched in, secondary multiplexing of the channels is not permitted.

The effectively transmitted passband of the channels	300 - 2,700 Hz
Residual channel attenuation at 800 Hz	0.8 Np
Maximum length of a retransmission section	400 km
The same, where voice frequency telegraphy is used	240 km
The maximum length of a repeater section for the following channels:	
I	80 km (60 km minimum)
II and III	40 km (30 km minimum)
Nominal relative transmit level at the output of the routing filters	+ 1.5 Np (with respect to power)
Channel stability (with one retransmission section)	0.6 Np
Maximum gain of the terminal and intermediate stations for the following channels:	
I (with AGC)	6.5 Np
II and III (with AGC)	6.5 Np
I (without AGC)	6.5 Np
II (without AGC)	5.5 Np.
The input impedance of the equipment looking into:	
the line	800 ohms
the station	600 ohms.

The AGC system	Electrical, single frequency, flat—slope type.
The AGC control frequencies for the following channels: I: Station A	9 KHz
Station B	3 KHz
II and III: Station A	13 KHz
Station B	22 KHz
The design frequencies for noise determination	8.7, 15.7 and 24.7 KHz
The psophometric value of the internal noise voltage in the terminal station channels at the 0.8 neper relative level point	0.6 mv
The channel nonlinearity factor when the amplitude limiter is cut out (with one retransmission section)	2.5 %
The reflection factor of the input impedance of the equipment from the: Station end in a two-wire channel when the isolating capacitor in a range of 0.3 - 2.7 KHz in inserted	0.1
Line end, with respect to 800 ohms	0.25
The voice frequency ringing frequency via the HF channels	2,100 Hz

Climatic Operational Conditions: At temperatures of from +10 to +40° C, and a relative ambient air humidity of 75%.

Electrical Power Supply: The equipment is powered from DC or AC sources, as well as remotely, from DC sources.

Voltages:

-- Local electrical power supplies:	
Plate	220 volts DC ± 10%
Filament	24 volts DC ± 10%
Mains	127/220 volts AC
-- Remote power	176 volts DC

Current and Power Consumption:

	1. Оборудование	2. Анод, ма	3. Накал, ма	Сеть 127/220 в, вт 4.
OVS	ОВС-3-1	100	670	60
OVS	ОВС-3-1у	35	400	44
OVS	ОВС-3-2/3	100	1600	110
OVS	ОВС-3-2у	35	400	44
PVS	ПВС-3-1	80	400	44
PVS	ПВС-3-2/3	80	400	44

[Key to Current and Power Consumption Table]:

1. Equipment;
2. Plate, ma;
3. Filament, ma;
4. 126/220 volt mains, watts.

Notes: a. The remote power for terminal stations (simplified) at 176 volts is 180 - 200 ma, and 185 - 200 ma for intermediate stations;

b. The OVS-3-2u stations have limitations in service because of the presence of telephony conflicting with the OVS-3-2/3 equipment.

The type of vacuum tubes employed: 10Zh1L or 12Zh1L for the case where the filament battery voltage is no lower than 21.6 volts.

Equipment Complement:

VS-3 rack: Frame with the common rack units (panels for fuses, intercom-callup unit, signaling, etc.), adapted for the installation of three stations: intermediate, terminal, or both of them and supplemental units.

OVS-3-1: Complete terminal station for channel I with AGC.

OVS-3-1u: Simplified terminal station for channel I without AGC.

OVS-3-2/3: Complete terminal station for channels II and III with AGC;

OVS-3-2u: Simplifier terminal station for channel II without AGC.

PVS-3-1: Intermediate station for channel I with AGC.

PVS-3-2/3: Intermediate station for channels II and III with AGC.

Supplemental Units:

-- Power supply panel for powering the equipment from the 127 or 220 volt AC mains;
-- The remote power transmission panel, DP, for feeding remote power to terminal or intermediate stations;
-- The DP receiver panel for the reception of remote power;
-- A panel of station matching devices, consisting of three transformers, one of which can be used as a balancing transformer in the low frequency channel;
-- A line matching unit, adapted for installation on a support [pole];
-- A compander for noise reduction in the high frequency channels;
-- DK-2.4 and BDK-2.4 bypass filters.

Construction: A frame of steel sections for the installation of the intermediate or terminal stations and supplemental devices. The dimensions of the rack are 2,500 x 665 x 425 mm.

Weight

Equipment		Weight, kg
Racks:	VS-3	75
	OVS-3-1	90
	OVS-3-1u	83
	OVS-3-2u	80
	OVS-3-2/3	140
	PVS-3-1	90
	PVS-3-2/3	90
Power supply unit		17
Remote power transmission panel		12
Remote power receive panel		12
Station matching unit		7
The same, for the line		5
Compander		15

View from the front   View from the side

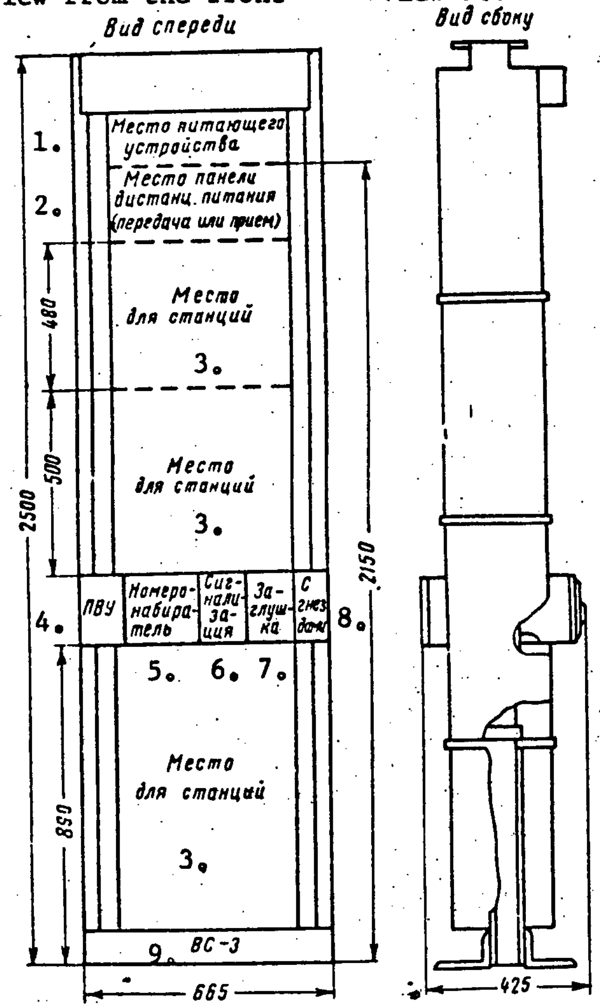


Figure 3.3.1.

The placement of the equipment in the rack with the common rack units of the VS-3 equipment.

Key:

1. Place for the power supply unit;
2. Place for the remote power supply panel (transmit or receive);
3. Place for the stations;
4. Intercom-callup unit;
5. Number dialer;
6. Signaling;
7. Blank panel;
8. Jacks;
9. VS-3.

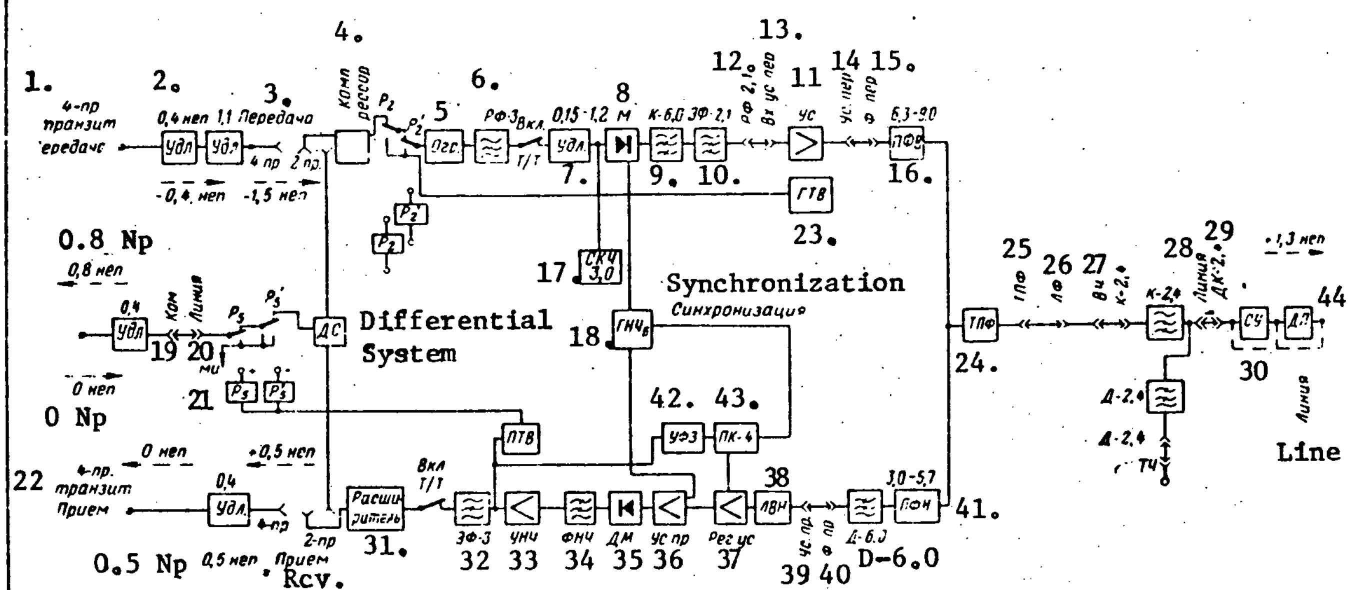


Рис. III.3.2 Блок-схема оконечной станции ОВС-3-1 с АРУ (включение фильтров показано для станции *А*. Для станции *Б* фильтры *ПФН* и *ПФБ*, *Д-6,0* и *К-6,0* меняются местами) аппаратуры ВС-3

Figure 3.3.2. Block diagram of the OVS-3-1 station with AGC of the VS-3 equipment (the insertion of the filters is shown for station A; for station B, the PFN and PFV, as well as the D-6.0 and K-6.0 filters change places).

Key:
1. Four-wire through-working, transmit;
2. 0.4 neper pad;
3. Transmit;
4. Compressor;
5. Limiter;
6. RF-3 [?3 KHz rejection filter?];
7. Pad;
8. M [?Modulator?];
9. K-6.0 filter;
10. ZF-2.1 [2.1 KHz suppression filter];
11. Amplifier;
12. RF 2.1;
13. Transmit amplifier input;
14. Transmit amplifier;
15. [?transmit filter input?];
16. PFV [?output bandpass filter?]
17. SKCh 3.0 [3.0 KHz control frequency ?circuit?];
18. GNCh$_B$ [B carrier frequency generator];
19. Kom [?switchboard?];
20. Line
21. MI [expansion unknown];
22. Four-wire through-working, receive;
23. GTV [voice frequency ringing generator];
24. TPF [expansion unknown];
25. TPF input;
26. LF [line filter];
27. VCh [?high frequency?];
28. Line;

[Key to preceding Figure 3.3.2, continued]:

29. DK-2.4 filter;
30. SU [matching unit];
31. Expander;
32. ZF-3 [suppression filter];
33. UNCh [low frequency amplifier];
34. High pass filter;
35. DM [?demodulator?];
36. Receive amplifier;
37. Control amplifier;
38. LVN [expansion unknown];
39. Receive amplifier;
40. F Pr [?receive filter?];
41. PFN [unknown type of bandpass filter];
42. UFZ [expansion unknown];
43. PK-4 [expansion unknown];
44. DP [remote power unit].

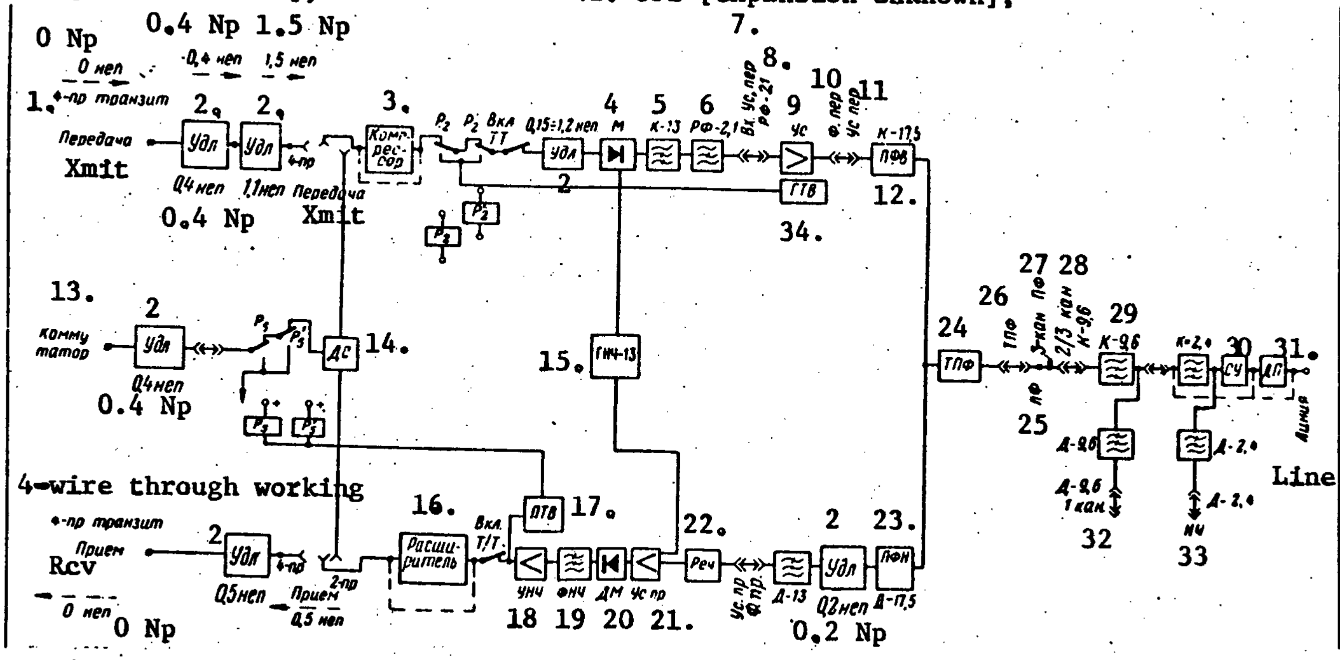


Figure 3.3.3. Block diagram of a simplified OVS-3-2u station. Station A of the VS-3 equipment (for station B, the PFN and PFV, as well as the K-13 and D-13 filters, change places).

Key:
1. Four-wire through-working;
2. Attenuator pad;
3. Compressor;
4. M [?modulator?];
5. K-13 filter;
6. RF-2.1 [?2.1 KHz rejection filter?];
7. Transmit amplifier input;
8. RF-2.1;
9. Amplifier;
10. [?transmit filter?];
11. Transmit amplifier;
12. PFV (K-17.5);
13. Switchboard;
14. Differential system;

[Key to preceding Figure 3.3.3, continued]:

15. GNCh-13 [?13 KHz carrier frequency generator?];
16. Expander;
17. PTV [expansion unknown];
18. Low frequency amplifier;
19. Low pass filter;
20. DM [?demodulator?];
21. Receive amplifier;
22. Rech [expansion unknown];
23. PFN (D-17.5) filter;
24. TPF [expansion unknown];
25. ?LF? [?line filter?];
26. TPF [expansion unknown];
27. 3-channel PF [bandpass filter];
28. 2/3 chan.
29. K-9.6 filter;
30. SU [matching unit];
31. DP [remote power unit];
32. Channel 1;
33. Low frequency

Вкл T/T = Voice frequency telegraphy switch [on].

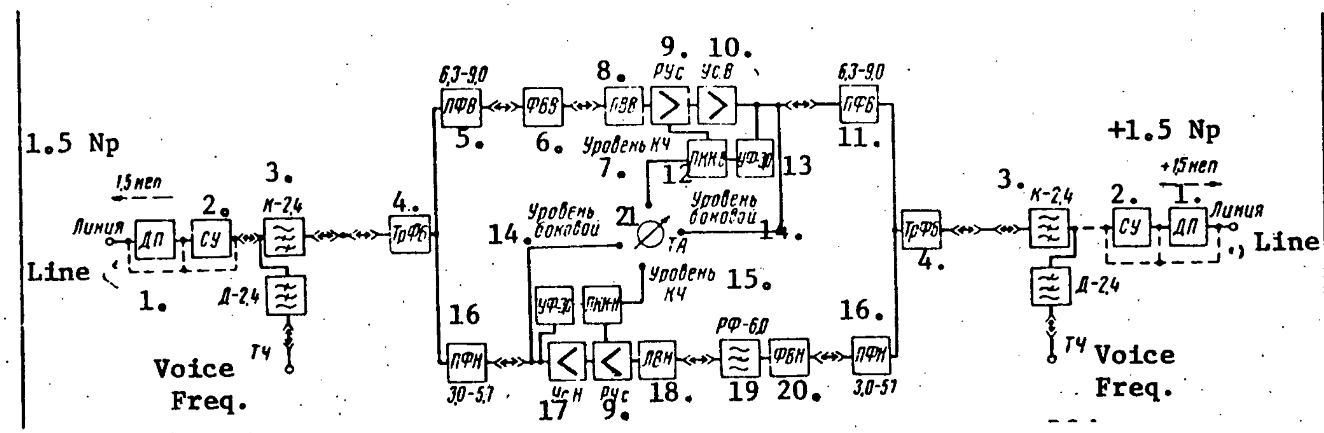


Figure 3.3.4. Block diagram of the PVS-3-1 intermediate station of the VS-3 equipment;

Key:
1. Remote power supply unit;
2. Matching unit;
3. K-2.4 filter;
4. Tr FB [?balancing transformer and filter?];
5. PFV [expansion unknown];
6. FVV [expansion unknown];
7. Control frequency level;
8. LVV [expansion unknown];
9. Rus [control amplifier];
10. UsV [unknown type of amplifier];
11. PFV;
12. PKK-V [unknown type of control channel receiver unit];
13. UF-3.0 [expansion unknown];
14. Side level;
15. Control frequency level;
16. PFN [expansion unknown];
17. UsN [unknown type of amplifier];

[Key to preceding Figure 3.3.4, continued]:

18. LVN [expansion unknown];
19. RF-6.0 [6.0 KHz rejection filter];
20. FVN [expansion unknown].

3.4. The V-3, V-3-3 and V-3-3s Three-Channel Transmission Systems (The V-3 has been taken out of production)

Figure 3.4.1 - 3.4.16.

Purpose: The units are designed for the following: The V-3 — for multiplexing copper or bimetal open-wire circuits; V-3-3 -- for multiplexing copper, bimetal and steel-open wire circuits; V-3-3s — for multiplexing steel open wire circuits, as well as VTSP 1 x 4 x 1.2 and PRPPM 1 x x 4 x 1.2 type cables on rural service telephone networks.

Type of Line Used: Steel, copper, and bimetal open-wire circuits, as well as VTSP and PRPPM cables.

Communication System: Two-band, electrically four-wire, physically two-wire.

Electrical Characteristics:

V-3 Line Frequency Spectrum:

A-B direction	6.3 - 14.7 KHz
B-A direction	18.3 - 26.7 KHz

Note: There is the option of organizing two spectra in the indicated frequency range (a main, and a supplemental one). The supplemental spectrum is the inverse of the main one. The terminal station can operate as either station A or station B.

	1. Направления передачи	2. Варианты линейных спектров аппаратуры В-3-3 и В-3-3с, кгц			
		I	II	III	IV
A-B	А—Б	4—16 (п)	4—16 (о)	4—16 (п)	4—16 (о)
B-A	Б—А	19—31 (п)	19—31 (о)	18—30 (п)	18—30 (о)

Key: 1. Transmission directions;
2. Variants of the line spectra of the V-3-3 and V-3-3s equipment, KHz.

Note: Here, and in the following in similar cases, п [p] is the regular arrangement of the channels in the line spectrum, and о [o] is the inverse.

The number of channels which can be organized:

V-3, V-3-3s	Three HF channels
V-3-3	Three HF channels and a two-band service communications (DPS) channel in the 0.3 - 2.94 KHz spectrum.

The effectively transmitted passband of the channels:

V-3	300 - 3,700 Hz
V-3-3, V-3-3s	300 - 3,400 Hz
DPS V-3-3	300 - 1,500 Hz.

Note: In the V-3 equipment, the frequency conversions in the A-B transmit direction are accomplished by means of shifting the voice frequency spectra of the first, second and third channels of 300 - 2,700 Hz with the 6.9 and 12 KHz carriers (the main spectrum) or the 9, 12 and 15 KHz carriers (supplemental spectrum) to the line frequency spectrum. In the B-A direction, the voice frequency channel spectra are shifted by the 27, 24 and 21 KHz carriers (main spectrum) and the 21, 24 and 18 KHz (supplemental spectrum) carriers respectively to the line frequency spectrum.

In the V-3-3 and V-3-3s equipment, the 300 - 3,400 Hz voice frequency spectrum is converted in the A-B direction by the 12, 16 and 20 KHz carriers with the formation of the pre-group (supplemental conversion) in the 12 - 24 KHz spectrum, which is then converted by the 72 or 108 KHz frequencies, with the formation of the 84 - 96 KHz spectrum (the regular and inverse arrangement respectively). In the third conversion stage, the 84 - 96 KHz spectrum is shifted by the 100 KHz frequency to to the 4 - 16 KHz line spectrum (direction A-B) or the 114 or 115 KHz frequency to the 18 - 30 KHz or 19 - 31 KHz line spectrum (direction B-A).

The back conversion is accomplished accordingly in the receive section of the equipment.

The capability of secondary multiplexing of HF channels:

V-3	One of the telephone channels can be used for 12 voice frequency telegraphy channels.
V-3-3	One of the telephone channels can be used for 12 voice frequency telegraphy channels; the DPS [two-band service communications] channel can be used for 6 voice frequency telegraphy channels.
V-3-3, V-3-3s	Instead of two telephone channels, there is the option of organizing a broadcast channel by means of supplement equipment (AV-2/3) via non-ferrous metal circuits. When multiplexing steel circuits, one of the telephone channels can be used for 12 voice frequency telegraphy channels (the first channel for variants I and III of the spectrum, or the third channel for variants II and IV).

The maximum communications range:

V-3, V-3-3	10,000 km via copper and bimetal open-wire circuits
V-3-3, V-3-3s	150 km via steel circuits where one OUP [attended repeater station] is present as well as four NUP's [unattended repeater stations], and 75 km when two NUP's are present.

Note: Because of the lack of AGC in the NUP's, and because of the fact that the transmit level at the output of the NUP's is less than at the OUP, it is necessary to locate the NUP, with respect to the station which transmits the upper group of frequencies (station B) as follows: with one NUP, at a distance of no more than 35 km; and with two NUP's, the first at 30 km and the second after 25 km.

V-3-3	54 km via VTSP 1 x 4 1.2 cable, where there are two NUP's
V-3-3s-u (simplified station without AGC)	23 km for a steel circuit without NUP's 25 km for VTSP 1 x 4 x 1.2 cable.

The length of a retransmission section for the V-3, V-3-3 — 2,000 km

The equalizable length of a repeater section:

V-3, V-3-3	80 - 250 km
V-3-3s	10 - 40 km

The nominal relative transmit level at the output of the stations:

V-3, V-3-3, V-3-3s (OUP, OP [terminal station])	+ 2.0 Np
V-3-3s-u (OP)	+ 0.6 $\pm$ 0.1 Np
V-3, V-3-3s (NUP)	+ 0.5 Np

The nominal relative level of the channels at voice frequencies:

Transmission in the four-wire section of the channel	- 1.5 Np
Reception in the four-wire section of the channel	+ 0.5 Np
Reception and transmission in the two-wire part of the channel	0.0 Np or -0.8 Np

The maximum gain of the line amplifiers of the OP and OUP's of the V-3 equipment:

A-B direction	3.7 Np
B-A direction	5.5 Np

The minimum permissible level at the input to the receive channel of the V-3-3 and V-3-3s equipment at 31 KHz under the following weather conditions:

Normal	- 4.3 Np
Severe (rime ice)	- 6.3 Np

The same for the lower group of frequencies: — - 1.8 and 5.5 Np respectively

The maximum gain of the NUP of the V-3-3 and V-3-3s equipment at 31 KHz — 4 Np

The minimum permissible level at the input to the receive channel at 31 KHz for the V-3-3s-u equipment	- 4.15 Np (under normal conditions with the option of increasing the gain by 2 Np by cutting out the pads).

The input impedance of the equipment from the:	V-3, ohms	V-3-3, V-3-3s V-3-3s-u, ohms
Line end:	600	100, 150, 600
Station end:	600	600

The voice frequency ring frequency:

V-3	1,000/20 Hz or 500/20 Hz, provision is made for DC transmission of the ring to the switchboard
V-3-3	2,100 Hz
V-3-3s	3,825 Hz (outside the HF [sic] channel)

The AGC system:

V-3	Two-frequency electromechanical and supplemental manual control
V-3-3, V-3-3s	Two-frequency flat and sloped type thermo-electromechanical.

Climatic Conditions:

The V-3, V-3-3 and V-3-3s (OP, OUP) equipment can operate in temperatures of from +10 to +40° C and a relative ambient air humidity of 80%. The V-3-3 and V-3-3s (NUP) equipment can operate in temperatures of from -10 to +40° C and a relative ambient air humidity of up to 98%.

Electrical Power Supply:

Voltages:

The V-3 is powered from the 127/220 volt AC mains or with direct current;

Plate: 206 volts regulated or 220 volts unregulated;
Filament: 21.2 volts regulated or 24 volts unregulated.

The V-3-3 is powered from the 127/220 volt AC mains or with direct current at 21.2 or 24 volts.

The V-3-3s is powered from the 127/220 volt AC mains or with direct current at 24 or 60 volts.

The V-3-3 and V-3-3s NUP [unattended repeater] (is powered remotely), with DC at 80 volts from 19/80 volt inverter, installed at the terminal stations instead of the 19 $\pm$ 2% voltage regulators and the DP [remote power] transmission board. The input voltage to the NUP amounts to 40 volts.

Current and Power Consumption

Equipment	Plate, amps 206 v.	Plate, amps 220 v.	Filament, amps 21.2 v.	Filament, amps 24 v.	Mains 127/220
OV-3 (single rack)	0.22	0.22	4.7	6.3	350 VA
Signaling	-	-	-	0.2-1.0	-
OV-3 (two-rack)	0.25	0.25	5.6	7.2	350 VA
Signaling	-	-	-	0.2-1.0	-
PV-3	0.18	0.18	3.5	4.7	300 watts
Signaling	-	-	-	0.1-0.9	-
OV-3-3 Tsv [nonferrous metals]	-	-	1.46	1.46	50 watts
OV-3-3 St [steel] with remote power transmission	-	-	2.1	2.1	75 watts
PV-3-3	-	-	1.9	1.9	66 watts
PV-3-3, with remote power transmission	-	-	2.3	2.3	80 watts
OV-3-3s	-	-	1.7	1.7	50 watts
OV-3-3s-u	-	-	0.9	0.9	25 watts
NUP V-3-3 (or V-3-3s)	40 ma from 80 volts DC				

Equipment Complement:

OV-3 (two-rack). It is housed in two racks: a group equipment rack, SGO, and an individual equipment rack, SIO.

OV-3 (single rack). It is housed in one rack. The group and individual equipment are mounted on both sides of the frame.

PV-3. It is housed in one rack.

Supplemental components for the V-3. The DK-2.8 and DK-5.7 filters, as well as the BDK-2.8 and BDK-5.7 balancing filters, by means of which the voice frequency channels, facsimile or broadcast channels are formed; the 550:140 line matching transformer and the PIEL-3 instrument.

OV-3-3 Tsv. Terminal station for multiplexing nonferrous metal circuits, and housed in a rack 2,600 mm high, in which two terminal stations and the DPS [two-band service communications] channel equipment can be mounted. Included in the station complement are: the power supply unit for converting the 127/ /220 volts AC to 24 volts DC; the matching autotransformer, AT, for matching the 600 ohm input impedance of the equipment to cable or steel circuits (100, 150 ohms and 800 ohms respectively); the filter equalizer, FV, of the VUS-12 for compensating for the amplitude-frequency distortion in a range of up to 31 KHz; the P-321 instrument case.

Note: Not included in the station complement is the DPS equipment and the companders (stipulated when ordering).

OV-3-3 St. Terminal station for multiplexing steel circuits with a layout similar to that of the OV-3-3 Tsv. Included in the station complement are: the power supply; autotransformer; companders and the P-321 instrument. The FV VUS-12 filter-equalizer and DPS equipment is not included in the station equipment complement.

PV-3-3. Universal amplifier station for multiplexing steel circuits or circuits of nonferrous metals. Included in the station complement are: power supply unit, autotransformer, FV VUS-12 filter-equalizer, the UF-18 and UF-30 narrow band filters for working in the different variants of the line spectrum, and the P-321 instrument. The DPS equipment is not included in the station complement (stipulated when ordering).

NUP V-3-3. An unattended repeater station for the V-3-3 and V-3-3s systems. Included in the NUP complement are: equipment for remote power transmission and a remote power voltage inverter, which are installed at the attended stations.

Supplemental devices for the V-3-3. The OV-3-3 RTsv is a complex of blocks for expanding the terminal station for nonferrous metal circuits. It is put together as a set just as the OV-3-3 Tsv, but without the P-321 instrument and the generator equipment.

OV-3-3RSt is a complex of expander blocks for the terminal station for steel circuits. It is put together as a set just as the OV-3-3 St, but without the P-321 insturment and the generator equipment.

PV-3-3R is a complex for expanding the intermediate station. It is put together as a set just as the PV-3-3, but without the P-321 instrument.

DPS is equipment for two-band service communications, and is installed at attended stations (one DPS set at a terminal station, and two at an intermediate station.

DPS-PP is a device for parallel connection to a PV-12 bypass channel at points where there are three-channel system HF amplifiers. It is installed in the PV-12 racks.

Equipment for organizing broadcast program transmission: the VO (broadcast equipment) and GN-V (broadcast generator) blocks.

Line matching devices, LSU.

Compander block for installation at terminal stations where necessary.

Block of DK-3.2 filters for separating the three-channel system signals and the voice frequencies, as well as for the organization of a DPS channel.

OV-3-3s. Terminal station for multiplexing steel circuits and VTSP and PRPPM cables. Two stations can be installed in a rack.

OV-3-3sr. A complex of blocks for expanding an OV-3-3s terminal station.

OV-3-3s-u. Simplified terminal station (without AGC). Two stations can be installed in a rack.

OV-3-3s-ur. A complex of blocks for expanding an OV-3-3s-u terminal station.

Construction:

V-3. They are housed in standard racks with the blocks filling both sides. The dimensions of the racks are 2,500 x 650 x 410 mm.

V-3-3, V-3-3s. They are housed in racks of lightweight metal frames, which, with facing sheets, take the form of cabinets for the V-3-3 equipment, with dimensions of 2,600 x 650 x 250 mm without the front wall. The dimensions

of the V-3-3s are 2,150 x 650 x 250 mm. The bases for mounting and connecting the equipment blocks into the circuitry are installed from the front side of the cabinet. The electrical connection of the blocks to the bases is made by means of plug connectors. (Each plug connector has 8 connections).

NUP V-3-3 (or V-3-3s). They are housed in a rectangular metal box with dimensions of 335 x 295 x 560 mm, and intended for installation in heated and unheated rooms. The NUP housing is made with a rubber seal for protecting the NUP equipment against the intrusion of moisture. The NUP is secured to the wall with brackets.

Weight and Cost

Equipment	Weight, kg	Cost, rubles
OV-3 (single rack type)	350	3,200
OV-3 (two-rack type)	400	3,200
PV-3	400	2,300
V-3 power supply unit	-	79
OV-3-3 Tsv for one system, without the supplemental units	130	2,776
OV-3-3 St for one system, without the supplemental units	130	2,930
OV-3-3r Tsv for one system	45	2,275
OV-3-3r St for one system	49	2,467
PV-3-3 for one system	132	2,377
PV-3-3r for one system	54	2,118
NUP V-3-3 (V-3-3s)	20	1,500
DPS	8	453
DPS-PP	16	537
Compander for the OV-3-3	1.2	82
DK-3.2 filter block for the V-3-3	3.5	64

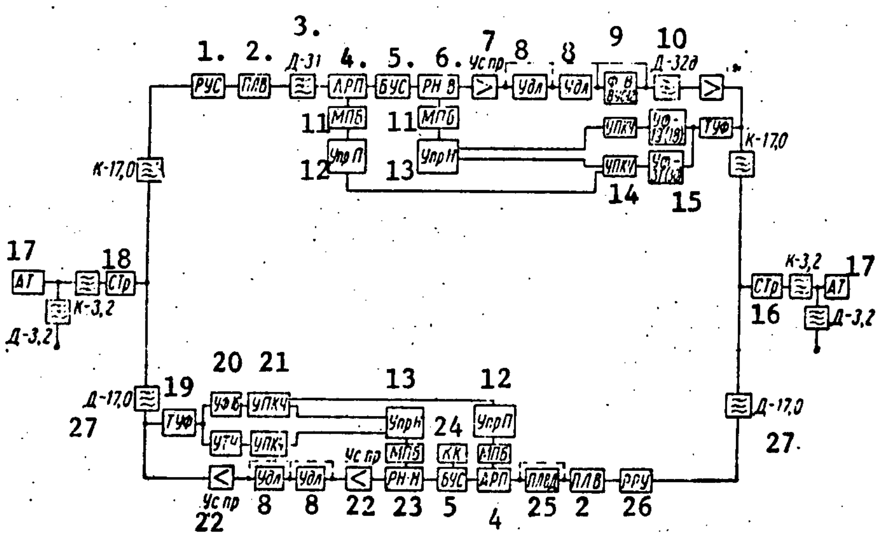


Figure 3.4.1. Block diagram of the intermediate attended station of the V-3-3 equipment.

[Key to Figure 3.4.1.]:

1. RUS [?gain control?];
2. PLV [expansion unknown];
3. D-31 filter;
4. ARP [expansion unknown];
5. BUS [?balancing amplifier?];
6. RN-V [expansion unknown];
7. Receive amplifier;
8. Pad;
9. VUS-12 filter-equalizer;
10. D-32d filter;
11. MPB [expansion unknown];
12. UPr P [flat type of control unit];
13. Upr N [slope type control unit];
14. UPKCh [?control channel receiver control unit?];
15. 31 (or 30) KHz narrow band filter;
16. STr [matching transformer];
17. AT [autotransformer];
18. Matching transformer;
19. TUF [unknown type of narrow band filter];
20. 16 KHz narrow band filter;
21. UPKCh;
22. Receive amplifier;
23. RN-N [expansion unknown];
24. Correcting network;
25. PLVD [expansion unknown];
26. RRU [expansion unknown];
27. D-17.0 [KHz] filter.

[Key to Figure 3.4.2]:

1. Fuse panel;
2. Ballast resistor panel;
3. Power supply unit;
4. Voice frequency ring receiver 1 panel;
5. The same, No. 2;
6. The same, No. 3;
7. Low frequency amplifier panel;
8. The same, No. 2;
9. The same, No. 3;
10. NM-5-47 neper meter;
11. Signaling panel;
12. Monitor and test unit block;
13. Two-wire intercom-callup unit block;
14. Four-wire intercom-callup unit block;
15. Jack panel for four wire connections;
16. Channel jack panel;
17. Junction line jack panel;
18. Blank panel;
19. Voice frequency ringing generator panel;

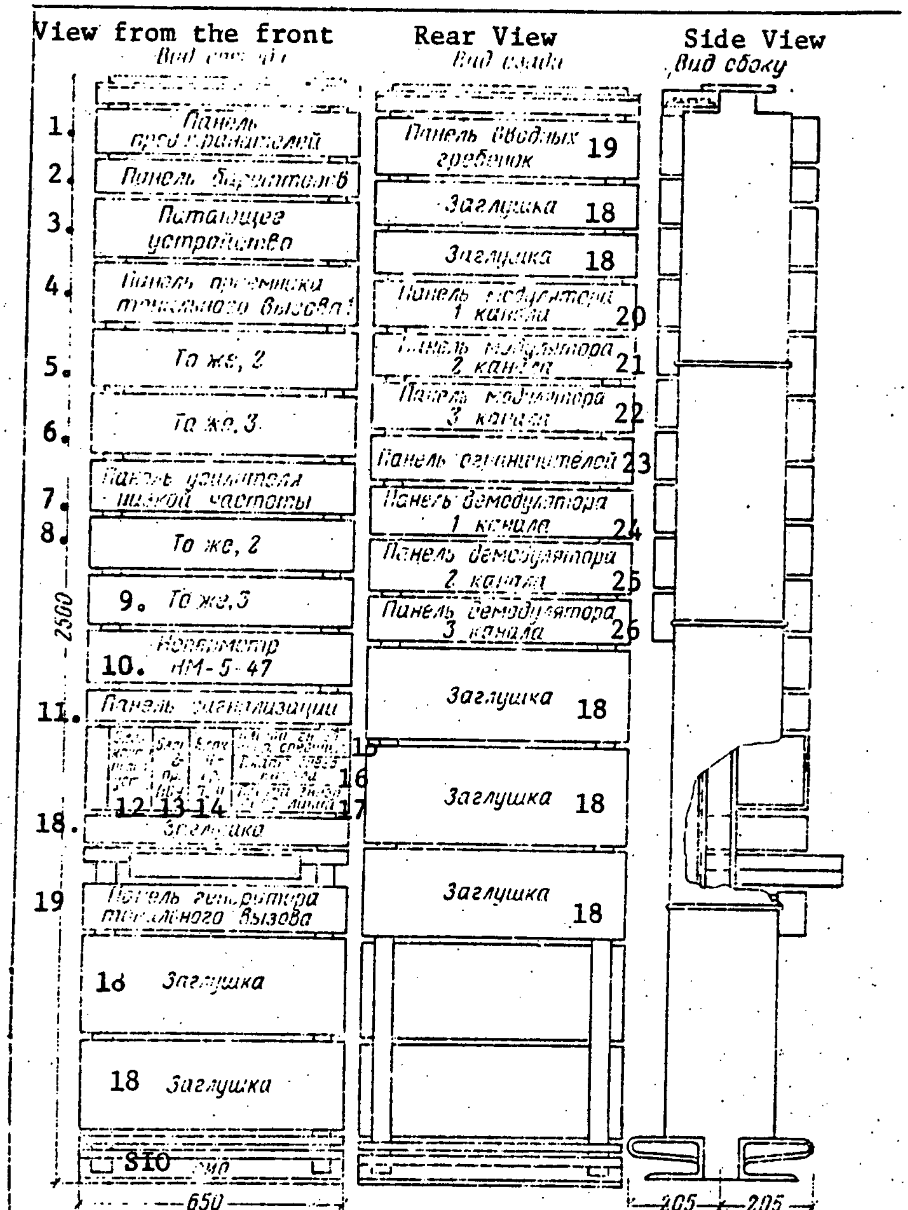


Рис. III.4.2. Размещение оборудования на стойке 1 3-канальной системы оконечной станции ОВ-3 (СИО) аппаратуры В-3

Figure 3.4.2. The placement of the equipment in rack one of the OV-3 (SIO) [individual equipment rack] three-channel system terminal station of the V-3 equipment.

Key [continued]:

20. Channel 1 modulator panel;
21. Channel 2 modulator panel;
22. Channel 3 modulator panel;
23. Limiter panel;
24. Channel 1 demodulator panel;
25. Channel 2 demodulator panel;
26. Channel 3 demodulator panel.

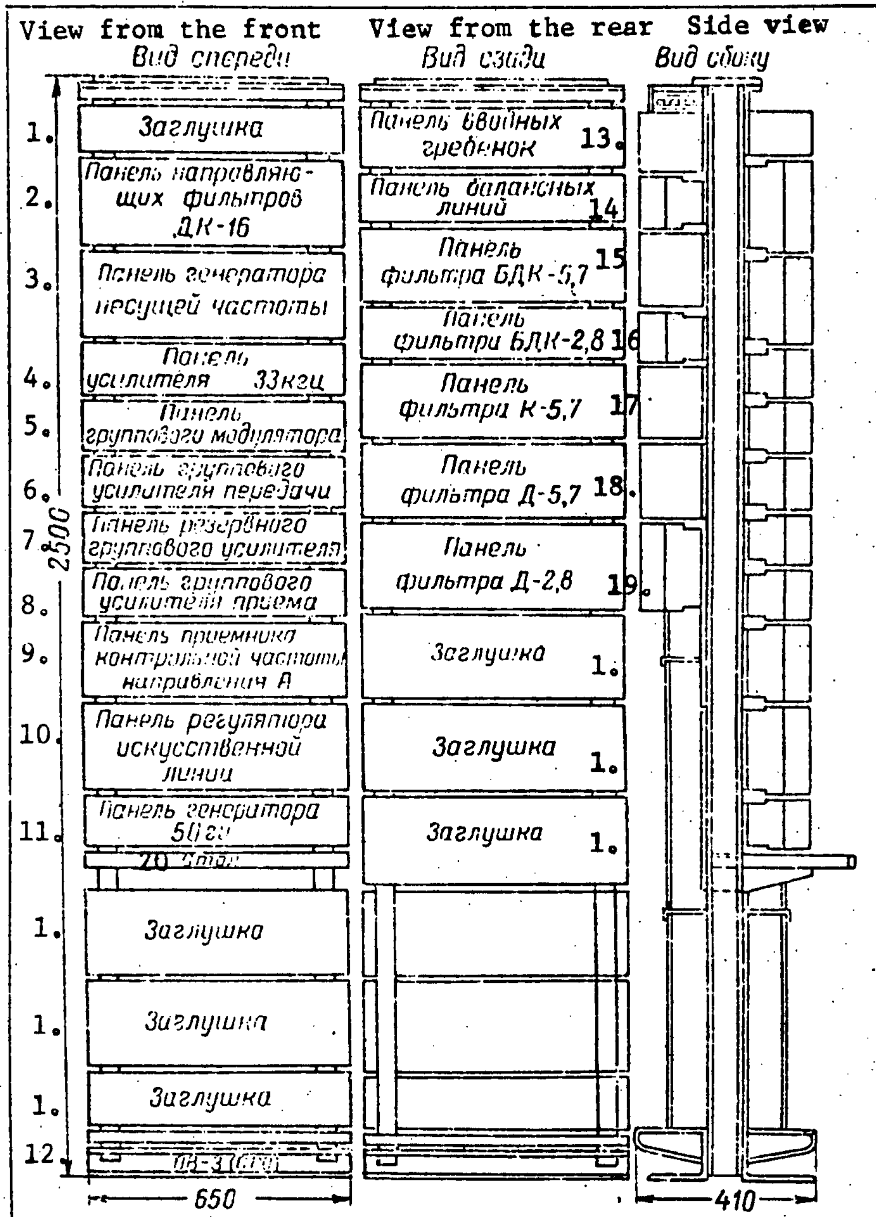


Рис. III.4.3. Размещение оборудования на стойке *2* 3-канальной системы оконечной станции ОВ-3 (СГО) аппаратуры В-3

Figure 3.4.3. The placement of the equipment in rack two of the OV-3 (SGO) [group equipment rack] three-channel system terminal station of the V-3 equipment.

Key: 1. Blank panel;
2. Panel of DK-16 routing filters;
3. Carrier frequency generator panel;
4. 33 KHz amplifier panel;
5. Group modulator panel;
6. Group transmit amplifier panel;

[Key to Figure 3.4.3, continued]:

7. Standby group amplifier panel;
8. Group receive amplifier panel;
9. Direction A control frequency receiver panel;
10. Phantom line adjuster panel;
11. 50 Hz generator panel;
12. OV-3 (SGO);
13. Panel of input terminal blocks;
14. Panel of compensation circuits;
15. BDK-5.7 filter panel;
16. BDK-2.8 filter panel;
17. K-5.7 filter panel;
18. D-5.7 filter panel;
19. D-2.8 filter panel;
20. Desk.

[Key to Figure 3.4.4]:

1. Power supply buses;
2. Fuse panel;
3. Power supply unit panel;
4. Low frequency amplifier panel;
5. Control frequency receive panel (direction A);
6. Phantom line adjustment panel;
7. Neper meter;
8. Signaling panel;
9. M/T [expansion unknown];
10. Monitor and test unit block;
11. Two-wire intercom-callup unit block;
12. Four-wire intercom-callup unit block;
13. Four-wire connecting jacks;
14. Channel jacks;
15. Junction line jacks;
16. Carrier frequency generator panel;
17. Panel of the group amplifier for receive;
18. Panel of the standby group amplifier;
19. Panel of the group amplifier for transmit;
20. 33 KHz amplifier and 50 Hz generator panel;
21. Group modulator panel;
22. Voice frequency ringing generator panel;
23. Input terminal blocks, ballast resistors and compensation circuit;
24. Place for the installation of a transparent panel.

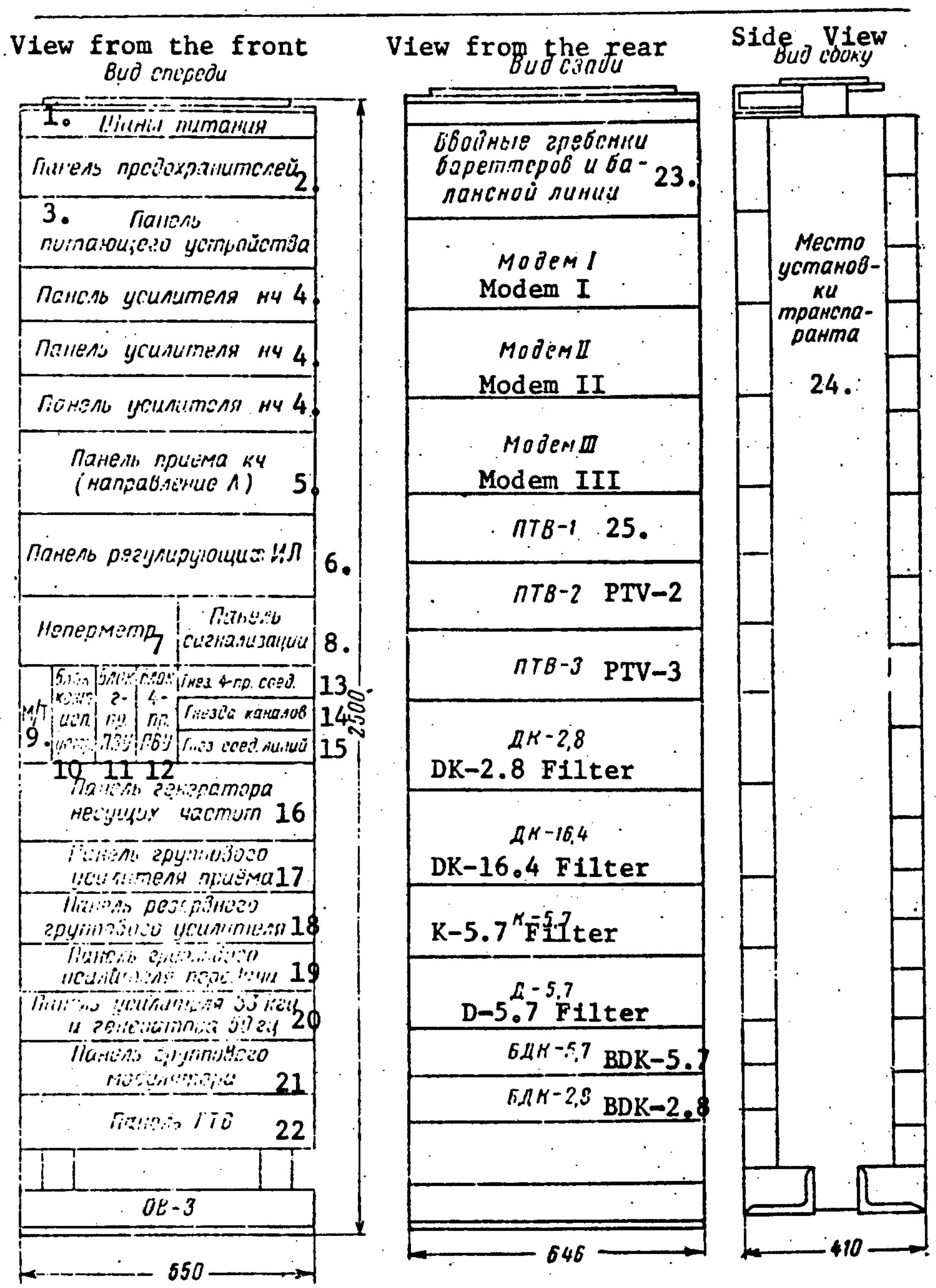


Рис. III.4.4. Размещение оборудования на оконечной станции 3-канальной системы ОВ-3 (одностоечный вариант) аппаратуры В-3

Figure 3.4.4. The placement of the equipment in the OV-3 (single rack variant) three-channel system terminal station of the V-3 equipment.

[Key on preceding page]

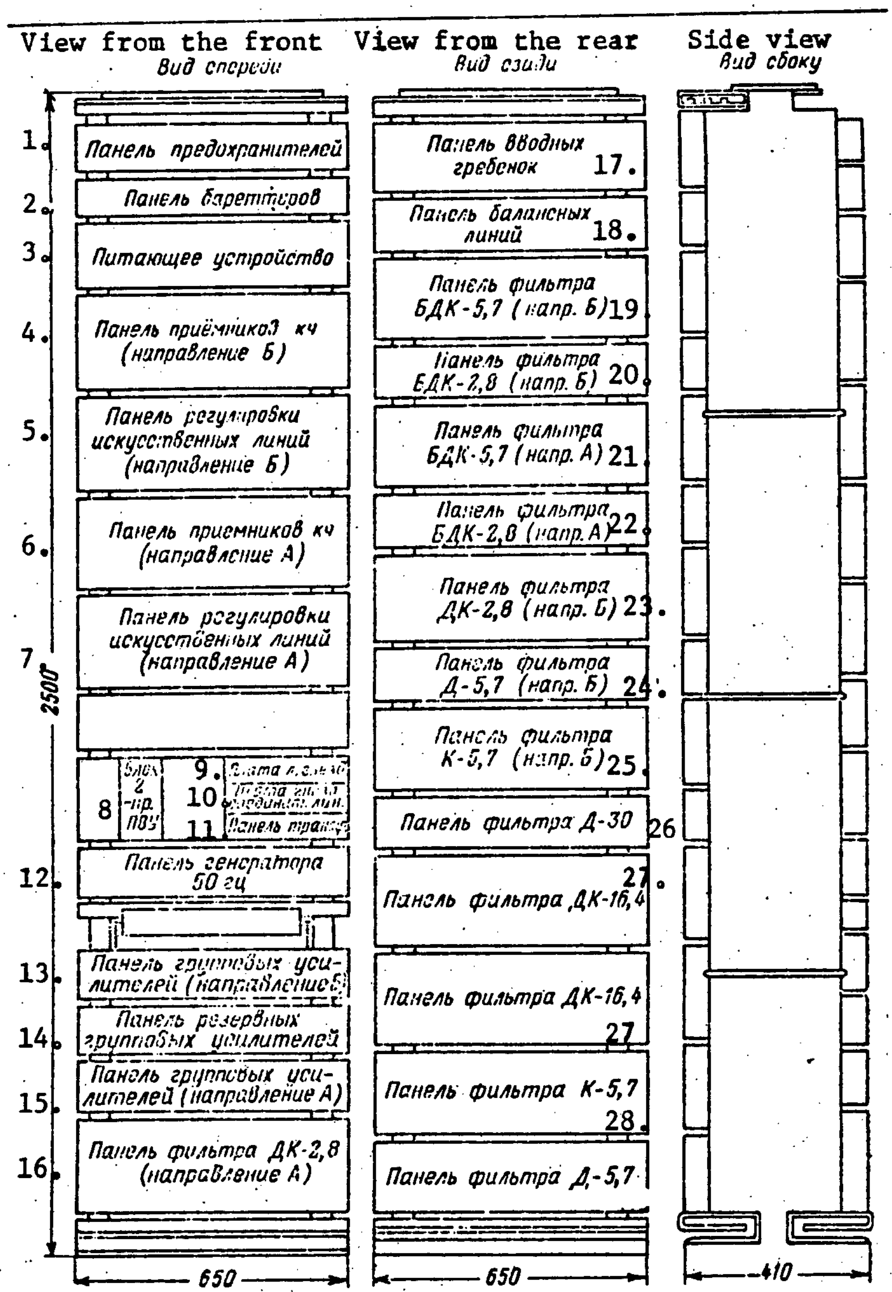


Рис. III.4.5. Размещение оборудования на промежуточной станции ПВ-3 аппаратуры В-3

Figure 3.4.5. The placement of the equipment in the PV-3 intermediate station of the V-3 equipment.

Key: 1. Fuse panel;
2. Ballast resistor panel;
3. Power supply unit;
4. Control frequency receiver panel (direction B);

[Key to Figure 3.4.5, continued]:

5. Phantom line adjustment panel (direction B);
6. Panel of control frequency receivers (direction A);
7. Phantom line adjustment panel (direction A)
8. Two-wire intercom-callup unit block;
9. Line jack panel;
10. Junction line jack panel;
11. Transformer panel;
12. 50 Hz generator panel;
13. Group amplifier panel (direction B);
14. Standby group amplifier panel;
15. Group amplifier panel (direction A);
16. DK-2.8 filter panel (direction A);
17. Panel of input terminal blocks;
18. Panel of compensation circuits;
19. BDK 5.7 filter panel (direction B);
20. BDK-2.8 filter panel (direction B);
21. BDK-5.7 filter panel (direction A);
22. BDK-2.8 filter panel (direction A);
23. DK-2.8 filter panel (direction B);
24. D-5.7 filter panel (direction B);
25. K-5.7 filter panel (direction B);
26. D-30 filter panel;
27. DK-16.4 filter panel;
28. K-5.7 filter panel;

[Key to Figure 3.4.6]:

1. TU_2 [Expansion unknown];
2. Limiter;
3. First channel;
4. Third channel;
5. Transmitter;
6. Transmit amplifier;
7. GN [?carrier generator?];
8. D-16.4 filter;
9. IKCh [expansion unknown];
10. KG [?crystal oscillator?];
11. F-33 filter;
12. 33 KHz amplifier;
13. TV [expansion unknown];
14. Differential system;
15. BK [balancing network];
16. PrNr [unknown type of receiver];
17. AGC receiver;
18. 50 Hz generator;
19. TK [?telephony channel?];
20. TU_3 [expansion unknown];
21. The individual equipment for three channels;
22. Low frequency amplifier;

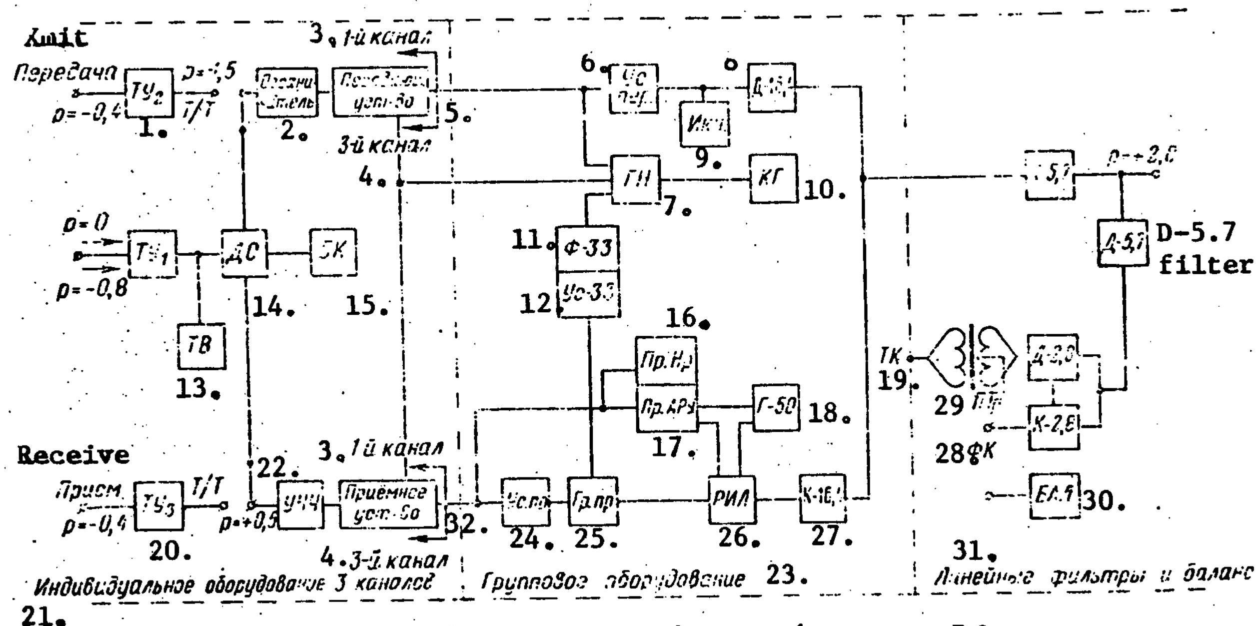


Рис. III.4.6. Блок-схема оконечной станции *A* аппаратуры В-3

Figure 3.4.6. Block diagram of terminal station A of the V-3 equipment.

[Key, continued]:
23. Group equipment;
24. Us. pr. [?receive amplifier?];
25. Gr. pr. [?group converter?];
26. Phantom line regulator;
27. K-16.4 filter;
28. FK [expansion unknown];
29. PTr [unknown type of transformer];
30. BAL [?balancing network?];
31. Line filters and balance [network];

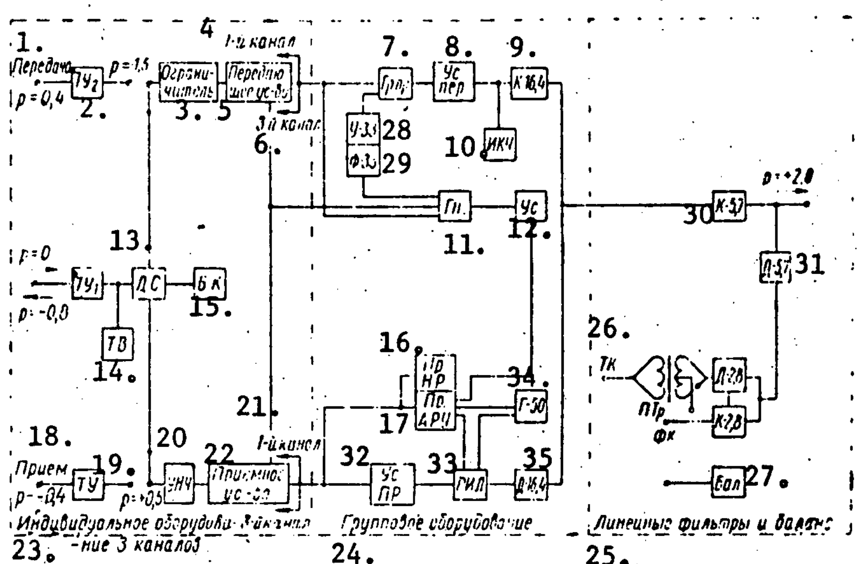


Рис. III.4.7. Блок-схема оконечной станции *Б* аппаратуры В-3

Figure 3.4.7. Block diagram of terminal station B of the V-3 equipment.

Key:
1. Transmit;
2. TU_2 [expansion unknown];
3. Limiter;
4. First channel;
5. Transmit unit;
6. Third channel;
7. Gr Pr [?group converter?];
8. Transmit amplifier;
9. K-16.4 filter;
10. IKCh [?control frequency meter?];
11. Generator;
12. Amplifier;
13. DS [differential system];
14. TV [expansion unknown];
15. BK [balancing network];
16. Pr NR [expansion unknown];
17. AGC receiver;
18. Receive;
19. TU [expansion unknown];
20. Low frequency amplifier;
21. First channel;
22. Receive unit;
23. Individual equipment of three channels;
24. Group equipment;
25. Line filters and balancing [network];
26. TK [?telephony channel?];
27. Balance;
28. U-33 filter;
29. F-33 filter;
30. K-5.7 filter;
31. D-5.7 filter;
32. [?receive amplifier?];
33. Phantom line adjuster;
34. 50 Hz generator;
35. D-16.5 filter.

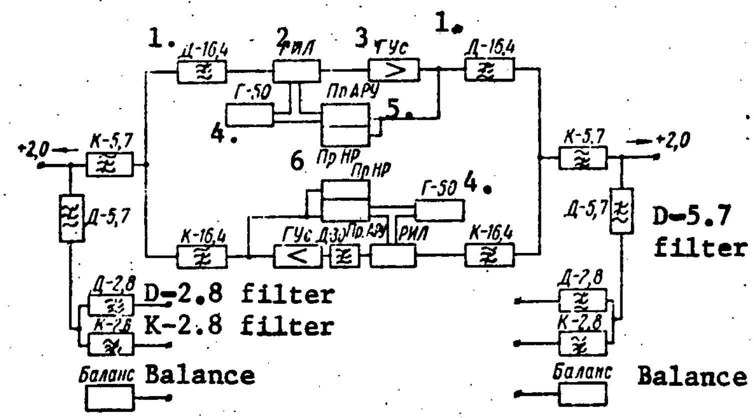


Рис. III.4.8. Блок-схема промежуточной станции аппаратуры В-3

Figure 3.4.8. Block diagram of the intermediate station of the V-3 equipment.

Key: 1. D-16.4 filter;
2. Phantom line adjuster;
3. Group amplifier;
4. 50 Hz generator;
5. AGC receiver;
6. Pr. NR [expansion unknown];

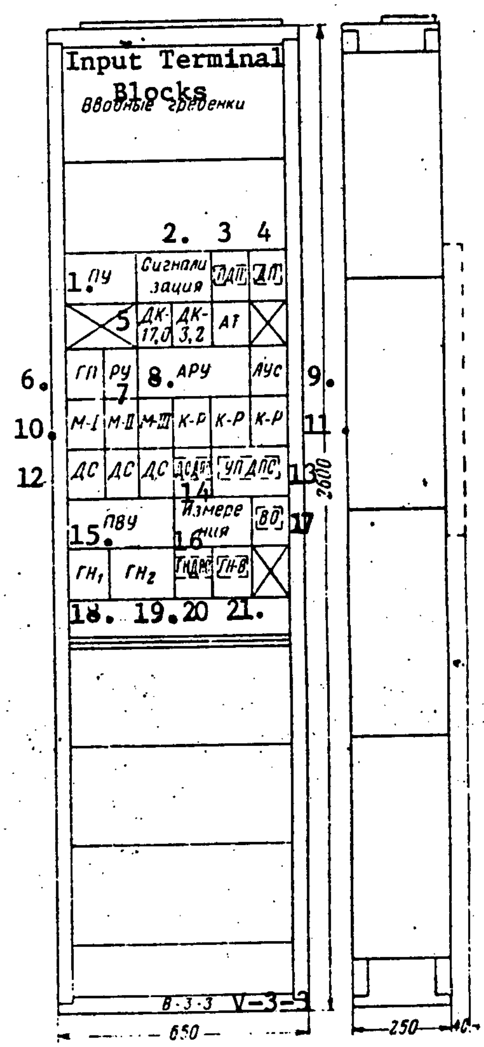


Figure 3.4.9. Equipment placement in the terminal station rack of the V-3-3 equipment (for one system).

Key: 1. Power supply unit;
2. Signaling;
3. Remote power transmit unit;
4. Remote power supply;
5. DK-17.0 filter;
6. GP [?group converter?];
7. RU [?gain control?];
8. Automatic gain control;
9. Line amplifier;
10. Modulator 1;
11. K-R [expansion unknown];
12. Differential system;
13. UPDPS [unknown type of two-band service communications unit];
14. DSDPS [Two-band service communications unit differential system??]

[Key to Figure 3.4.9, continued]:

15. Intercom-callup unit;
16. Measurements;
17. VO [broadcast unit];
18. GN_1 [?carrier generator 1?];
19. GN_2;
20. GNDPS [?two-band service communications carrier generator?];
21. GN-V [broadcast generator].

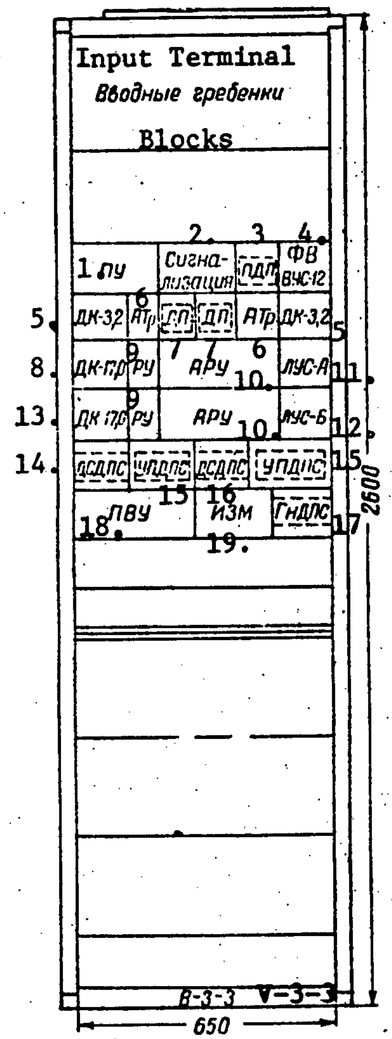
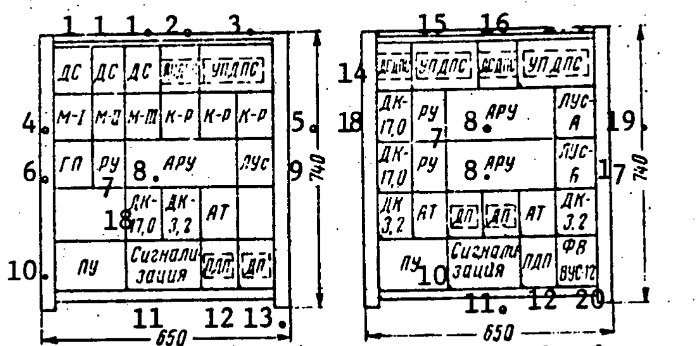


Figure 3.4.10. The equipment placement in the V-3-3 equipment intermediate station rack (for one system).

Key:
1. Power supply unit;
2. Signaling;
3. Remote power transmit unit;
4. FV VUS-12 [VUS-12 (auxiliary amplifier) filter-equalizer];
5. DK-3.2 filter;
6. ATr [?autotransformer?];
7. DP [remote power unit];
8. DK-17.0 filter;
9. RU [?level control?];
10. ARU [automatic gain control, AGC];
11. LUS-A ["A" line amplifier];
12. LUS-B ["B" line amplifier];
13. DK-17.0 filter;
14. DSDPS [?two-band service communications unit remote signaling?];
15. UPDPS [expansion unknown];
16. DSDPS;
17. GnDPS [?two-band service communications generator?];
18. PVU [intercom-callup unit];
19. Meter.



21. Комплект блоков развития станции ОВ-3-3(ОВ-3-3-РСТ)

Комплект блоков развития станции ПВ-3-3 (ПВ-3-3-Р) 22

Figure 3.4.11. The placement of the equipment in the sets of expander blocks for the OV-3-3 and PV-3-3 stations.

Key: 1. Differential system;
2. DSDPS [?remote signaling for the two-band service communications?];
3. UPDPS [expansion unknown];
4. M-I [modulator I];
5. K-R [expansion unknown];
6. GP [?group converter?];
7. RU [?level control?];
8. Automatic gain control;
9. Line amplifier;
10. PU [?transmit unit?];
11. Signaling;
12. Remote power transmit unit;
13. Remote power supply
14. DSDPS;
15. UPDPS;
16. DSDPS;
17. "B" line amplifier;
18. DK-17.0 filter;
19. "A" line amplifier;
20. VUS-12 filter-equalizer;
21. Set of expander blocks for the OV-3-3 (or OV-3-3-RST) station;
22. Set of expander blocks for the PV-3-3 (or PV-3-3-R) station.

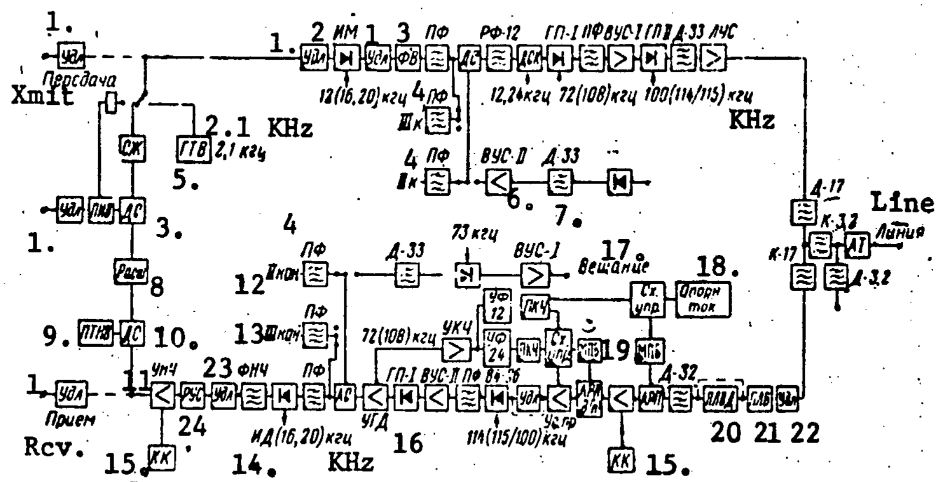


Рис. III.4.12. Блок-схема оконечной станции аппаратуры В-3-3

Figure 3.4.12. Block diagram of the terminal station of the V-3-3 equipment;

Key:
1. Pad;
2. IM [unknown type of modulator];
3. FV [filter--equalizer];
4. PF [bandpass filter];
5. GTV [voice frequency ring generator];
6. VUS-II [auxiliary amplifier station II];
7. D-33 filter;
8. [?expander?];
9. PTNV [voice frequency dial--ring receiver];
10. Differential system;
11. Low frequency amplifier;
12. Channel II
13. Channel III;
14. ID [unknown type of detector];
15. KK [correcting network];
16. UGD [unknown type of amplifier];
17. Broadcast;
18. Reference current;
19. MPB [expansion unknown];
20. PLVD [expansion unknown];
21. PLV expansion unknown];
22. Pad;
23. FNCh [low pass filter];
24. RUS [?level control?].

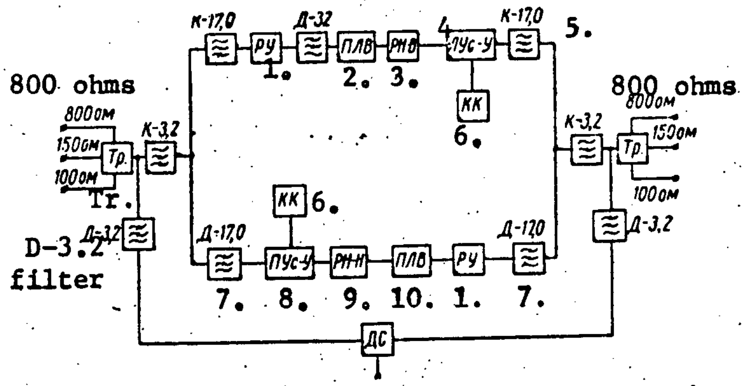


Рис. III.4.13. Блок-схема промежуточной необслуживаемой станции аппаратуры В-3-3 (В-3-3с)

Figure 3.4.13. Block diagram of an intermediate unattended station of the V-3-3 (or V-3-3s) equipment.

Key: 1. RU [?gain control?];
2. PLV [expansion unknown];
3. RN-V [expansion unknown];
4. Unknown type of line amplifier;
5. K-17.0 filter;
6. Correcting network;
7. D-17.0 filter;
8. PUs-U [unknown type of amplifier];
9. RN-N [expansion unknown];
10. PLV.

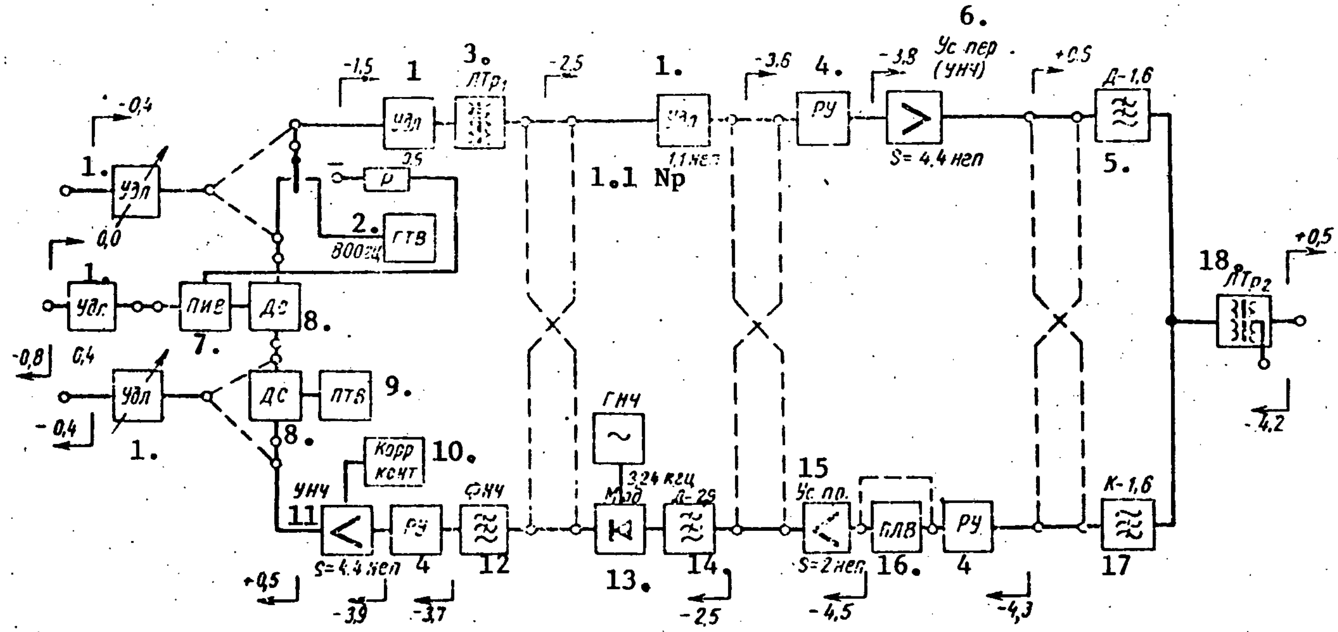


Рис. III.4.14. Блок-схема оконечной станции ДПС аппаратуры В-3-3

Figure 3.4.14. Block diagram of the DPS [two-band service communications] terminal station of the V-3-3 equipment.

Key:
1. Attenuator pad;
2. 800 Hz GTV [voice-frequency ring generator];
3. Line transformer 1;
4. RU [?level control?];
5. D-1.6 filter;
6. Transmit amplifier (UNCh) [low frequency amplifier];
7. PIV [selective call receiver];
8. Differential system;
9. PTV [voice-frequency ring receiver];
10. Correcting network;
11. Low frequency amplifier;
12. Low-pass filter;
13. Modulator;
14. D-2.9 filter;
15. Receive amplifier;
16. PLV [?type of equalizing network?];
17. K-1.6 filter;
18. Line transformer 2.

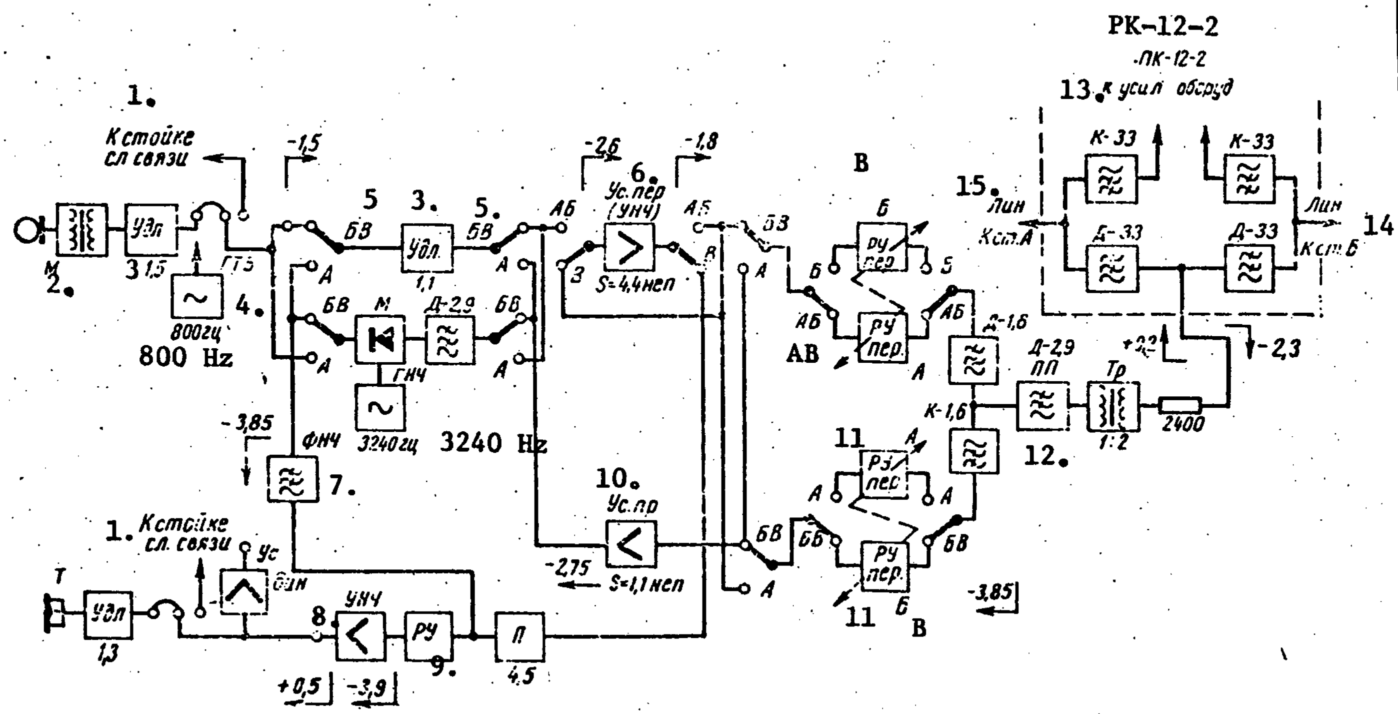


Figure 3.4.15. Block diagram of the parallel connection station, DPS-PP, of the V-3-3 equipment.

Key:
1. To the junction line communications rack;
2. Microphone;
3. Pad;
4. GTV [voice-frequency ring generator];
5. BC;
6. Transmit amplifier (low frequency amplifier);
7. Low pass filter;
8. Low frequency amplifier;
9. Level control;
10. Receive amplifier;
11. Variable level control;
12. PP [expansion unknown];
13. To the amplifier equipment;
14. Line to station B.
15. Line to station A.

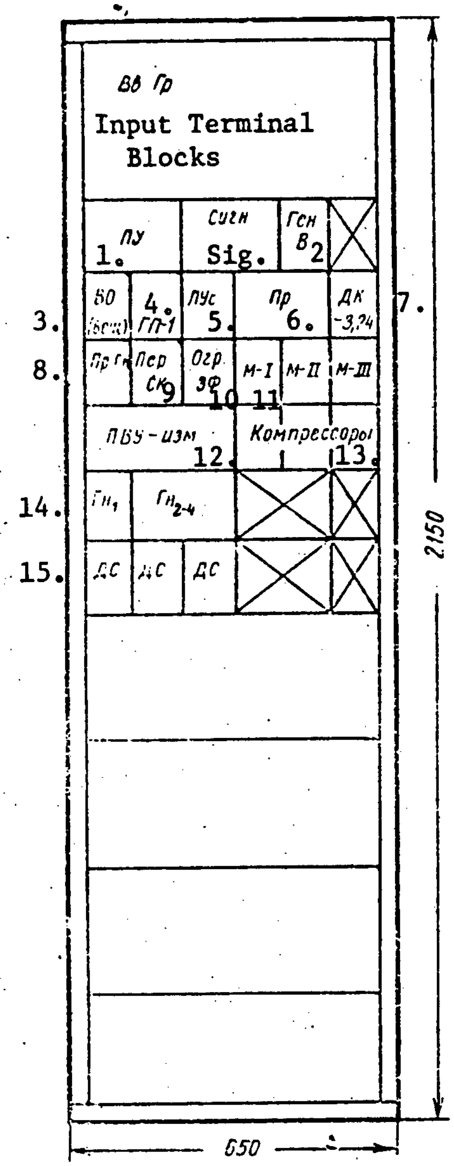


Рис. III.4.16. Размещение оборудования на стойке оконечной станции В-3-3с на 1 систему

Figure 3.4.16.

The placement of the equipment in the terminal rack of the V-3-3s station, for one system.

Key:

1. Power supply unit;
2. "B" generator;
3. Input equipment (broadcasting);
4. GP-1 [?group converter 1?];
5. Line amplifier;
6. Receiver;
7. DK-3.24 filter;
8. Pr S? [expansion unknown];
9. Per SK [?matching network transmit unit?];
10. Limiter, suppression filter;
11. Modulator I;
12. Intercom-callup unit, meter;
13. Compressors;
14. Gn_1 [?generator 1?];
15. DS [differential system].

3.5. The BTO-3/4, BO-3 and BO-3-2 Three-Channel Transmission System (Manufactured in the Hungarian People's Republic)

Figures 3.5.1 - 3.5.6.

Purpose: Intended for multiplexing open-wire communications lines. Supplied at the present time is the BO-3-2 equipment, which is the modernized variant of the BTO-3/4 and BO-3 equipment.

Type of Line Used: Open-wire copper or bimetal circuits, as well as open-wire steel circuits for the BO-3-2 system, which can be employed on both nonferrous metal circuits and on steel circuits.

The Communications System: Two-band, electrically four-wire, physically two-wire.

Electrical Characteristics:

Line Spectrum

Каналы Channels	5. Варианты линейных спектров аппаратуры, кгц BTO–3/4 БТО-3/4; БО-3 BO–3			
	A	B	C	D
1. Телефонные (направление А—Б)	4—16 (п)	4—16 (п)	4—16 (о)	4—16 (о)
2. То же (направление Б—А)	19—31 (п)	18—30 (о)	18—30 (п)	19—31 (о)
3. Телеграфные (направление А—Б)	3,18—3,62	3,18—3,62	3,18—3,62	3,18—3,62
4. То же (направление Б—А)	18,18—18,62	30,38—30,82	30,38—30,82	18,18—18,62

Каналы Channels	BO–3–2 БО-3-2			
	A	B	C	D
1. Телефонные (направление А—Б)	4—16 (п)	4—16 (о)	4—16 (о)	4—16 (п)
2. То же (направление Б—А)	19—31 (п)	18—30 (о)	18—30 (п)	19—31 (о)
3. Телеграфные (направление А—Б)	3,18—3,62	3,18—3,62	3,18—3,62	3,18—3,62
4. То же (направление Б—А)	18,18—18,62	18,18—18,62	30,38—30,82	30,38—30,82

Примечание. Прямое положение каналов — п, обратное — о.

Key: 1. Telephone (A-B direction);
2. The same (B-A direction);
3. Telegraph (A-B direction);
4. The same (B-A direction);
5. Variants of the equipment line spectra, KHz.

Note: The standard position of the channels is indicated by a п [p], and the inverse by о.

Number of channels which can be organized	BTO-3/4; BO-3;	BO-3-2
Telephone channels	3	3
Telegraphy channels	4	3 or 4 at a telegraph speed of 75 or 50 bauds respectively

	BTO-3/4; BO-3	BO-3-2
Effectively transmitted passband of the channels:		
Telephone channels	300-3,400 Hz	300-3,400 Hz
Telegraph channels	380-820 Hz (carrier frequencies of 420, 540, 660 and 780 Hz)	380-820 Hz (carrier frequencies of 420, 600 and 780 Hz).

Note: In the BTO-3/4, BO-3 and BO-3-2 equipment, just as in the domestic V-3-3 and V-3-3s equipment, the frequency conversion circuitry is based on preliminary group modulation. The 300 - 3,400 Hz voice frequency spectrum is converted in the transmit channel using individual frequencies of 12, 16 and 20 KHz with the formation of the pre-group in the 12 - 24 KHz spectrum.

The 12 - 24 KHz pre-group is converted using frequencies of 72 or 108 KHz with the formation of an 84 - 96 KHz spectrum (regular or inverse configuration respectively). In the third conversion stage, the 84 - 96 KHz spectrum is converted by a 100 KHz frequency to derive the 4 - 16 KHz (A - B) line spectrum, or frequencies of 114 and 115 KHz to derive the 18 - 30 KHz and 19 - 31 KHz (B - A) line spectra respectively. The back conversion is carried out in a corresponding manner in the receive part of the equipment.

Secondary multiplexing capability:	One of the telephone channels can be used for 12 voice frequency telegraphy channels. Instead of two telephone channels, a broadcast channel can be organized by means of the supplemental equipment (AV-2/3).
The maximum communications range using non ferrous metal circuits	10,000 km
The length of a retransmission section	2,000 km
The length of a repeater section which can be equalized	80 - 250 km
The maximum communications range over steel circuits using the BO-3-2 equipment	150 km under "winter-dry" and "20 mm rime ice" conditions when there is one OUP and four NUP's; 50 km between terminal stations without an OUP and NUP; 100 km where one OUP is present.
The nominal relative transmit level at the output of the stations:	
Terminal and attended repeater stations	+2.0 ± 0.1 Np
The BO-3-3 unattended repeater station	+0.5 Np.

The nominal relative levels of the channels with respect to the voice frequencies:	
Transmission in the 4-wire section of a channel	-1.5 Np
Reception in the 4-wire section of a channel	+0.5 Np
Reception and transmission in the two-wire section of a channel	0.0 Np or -0.8 Np
The maximum attenuation of a repeater section which can be compensated by the OP [terminal station] or OUP [attended repeater] at a frequency of 31 KHz	7.5 Np
The maximum gain of the BO-3-2 NUP at a frequency of 31 KHz	4.0 Np
The input impedance looking into the line of the:	
OP and OUP equipment:	
For ferrous metal circuits	600 ohms
For steel circuits	800 ohms
The BO-3-2 NUP equipment	800 ohms
The input impedance of the OP, OUP and NUP equipment looking into the stations	600 ohms
The AGC system	Electromechanical and supplemental manual control
The AGC control frequencies:	
A - B direction	16.11 KHz
B - A direction	31.11 KHz
The monitor and measurement frequency:	
A - B direction	3.81 KHz
B - A direction	17.81 KHz
The voice frequency ring frequency:	
BTO-3/4	3,825 Hz
BO-3	2,100 Hz
BO-3-2	2,100 Hz or 3,825 Hz (Changeover made by resoldering).

The Climatic Operational Conditions:

Temperatures of from +10 to +35° C and a relative ambient air humidity of 80 % for OP's and OUP's; temperatures of from +5 to +40° C and a relative humidity of 80% at 20° C for a VUS [auxiliary amplifier station]. A short term exposure of the equipment (24 hours) to conditions where the relative humidity is 95% at 25° C is permitted.

Electrical Power Supply:

Voltages: BO-3/4 -- From the 110/220 volt AC mains or from a DC source
Plate: 130 volts or 220 volts
Filament: 21.2 volts or 24 volts.

BO-3; BO-3-2: From the 110, 127 or 220 volt AC mains, or from a DC source:

21.2 volts ± 3% or 24 volts ± 10% (the equipment uses transistors.

BO-3-2 NUP is powered remotely 40 volts ± 10% (the voltage at the output of the remote power block is 50 - 90 volts).

Note: A provision is made in the power supply blocks of the BO-3-2 equipment for automatically switching the equipment power over to a storage battery when the AC mains voltage is lost.

Current and Power Consumption

Equipment	Filament, amps 21.2 v	Filament, amps 24 v	Plate, amps 130/220 v	220 volts AC VA (watts)
BTO-3/4, terminal	2.8	2.8	0.36	170
The same, repeater	1.4	1.4	0.14	80
BO-3, terminal	-	-	-	-
The same, repeater	-	-	-	-
BO-3-2, terminal, for one system	1.3	1.0	-	95
The same, for two systems	2.6	1.5	-	150
The same, for one system with remote power in one direction	1.5	1.0	-	105
The same, for one system, with remote power in two directions	1.7	1.0	-	112
The same, for two systems, with remote power in four direction	3.4	1.5	-	200
NUP BO-3-2, remote power	0.5	-	-	-

Equipment Complement:

BO-3/4. Terminal station with telegraph equipment. Terminal station for two systems without telegraph equipment. Small size terminal sta-station for one system without telegraph equipment.
Amplifier station for two systems.
Small size amplifier station for one system.

BO-3. Terminal station for one or two systems with telegraph equipment. Amplifier station for one or two systems.

BO-3-2. Terminal station without the remote power supply unit, and with companders, is supplied with the equipment for six telephone channels. The type BO-3-2 terminal station comes with the wiring for six telephone channels, without the remote power supply, with companders, the DK-3.0 balancing filter and a balancing transformer. (It is supplied with the equipment for three telephone channels.)

The type BO-3-3T terminal station with the wiring for three telephone and three telegraph channels (75 bauds) comes with the remote power supply, companders, DK-3.0 balancing filter and balancing transformer. The station can be supplied with the equipment for telegraph channels,

with or without the remote power supply unit.
The type BO-3-4T terminal station for four telegraph channels (50 bauds). The station can be supplied with the same equipment complement as the BO-3-3T, but without the balancing filter and the transformer, which can be ordered separately.

The BO-3-2 intermediate station with the wiring for two systems, with the remote power supply equipment for powering the NUP's. The station can be supplied for two systems or one system, with one or two remote power supply sets, or without them. When the station is supplied for one system, it is also complemented with two DK-3.0 balancing filters and two voice frequency transformers.
When the station is supplied for two systems, also supplied with it is the requisite number of balancing filters and transformers specified in the order.

The NBO-3-2 unattended intermediate station for steel circuits, with a remote power supply option. The NBO-3-2 station is supplied in two models: a room model, mounted on the walls of unheated rooms, and a pole model, mounted on poles.
The stations are supplied with the wiring for two systems and with the blocks for one system. The set of spare parts for the BO-3-2 stations is supplied for every 20 stations on special order.

Construction:

BO-3/4: The terminal and amplifier stations are housed in racks made of sectional steel with dimensions of 2,735 x 680 x 220 mm; the small size terminal stations are mounted in racks, the dimensions of which are 1,527 x 680 x 220 mm, while the amplifier stations are mounted in racks, the dimensions of which are 1,644 x 680 x 200 mm.

BO-3: The terminal stations are housed in racks made of sectional steel with dimensions of 2,600 x 660 x 250 mm, and the amplifier stations are housed in 2,600 x 660 x 250 mm racks.

BO-3-2: The terminal and amplifier stations are housed in racks made of sectional steel with dimensions of 2,600 x 680 x 250 mm.

Weight:

	no more than, kg
BO-3-2 OP for 1 system	200
The same, for 2 systems	250
BO-3-2 OUP for 1 system	150
The same, for 2 systems	200
BO-3-2 NUP	80

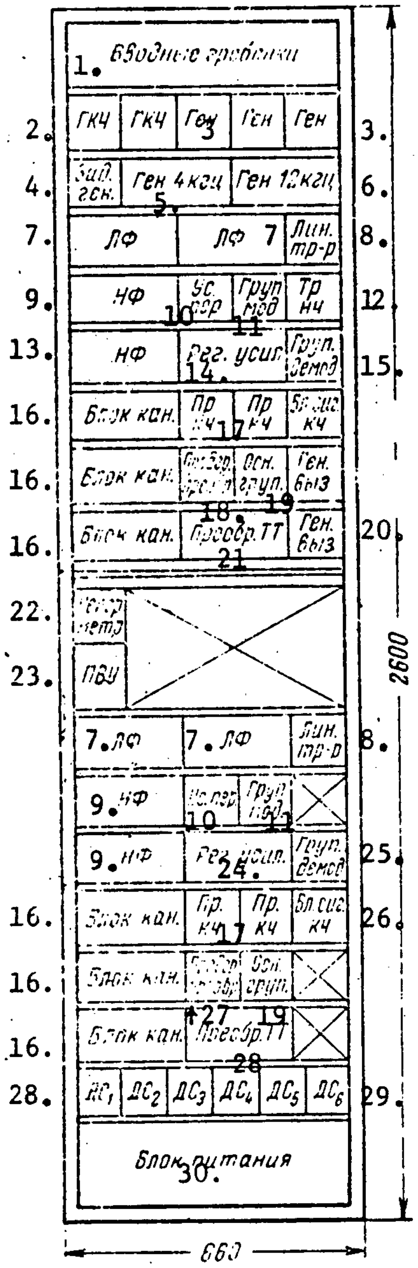


Рис. III.5.1. Размещение оборудования на стойке оконечной станции аппаратуры БО-3

Figure 3.5.1. The placement of the equipment in the terminal station rack of the BO-3 equipment.

Key:
1. Input terminal blocks;
2. GKCh [control frequency generator];
3. Generator;
4. Master oscillator;
5. 4 kHz generator;
6. 12 kHz generator;
7. LF [line filter];
8. line transformer;
9. NF [routing filter];
10. transmit amplifier;
11. group modulator;
12. low frequency transformer;
13. routing filter;
14. gain control;
15. group demodulator;
16. channel block;
17. control frequency receiver;
18. pre-group converter;
19. main group;
20. ring generator;
21. AF telegraphy converter;
22. Np meter;
23. intercom-call up unit;
24. gain control;
25. group demodulator;
26. control frequency signaling block;
27. pre-group converter;
28. AF telegraphy converter;
29. differential system 6;
30. power supply block.

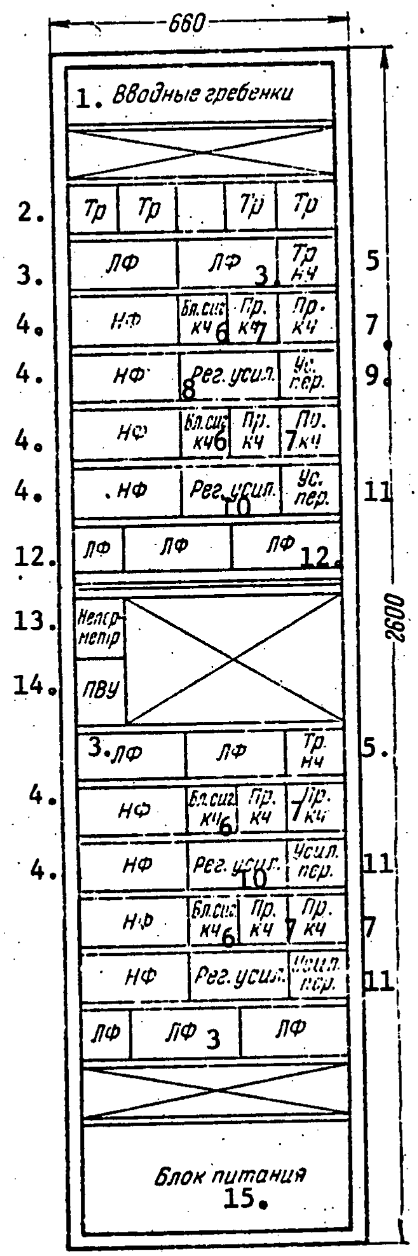


Рис. III.5.2. Размещение оборудования на стойке промежуточной станции аппаратуры БО-3

Figure 3.5.2. The placement of the equipment in the intermediate station rack of the BO-3 equipment.

Key:
1. Input terminal blocks;
2. Transformers;
3. LF [line filters];
4. NF [routing filter];
5. low frequency transformer;
6. control frequency signaling block;
7. control frequency receiver;
8. gain control;
9. [?transmit amplifier?];
10. gain control;
11. [?transmit amplifier?];
12. line filter;
13. Np meter;
14. intercom-call up unit;
15. power supply block.

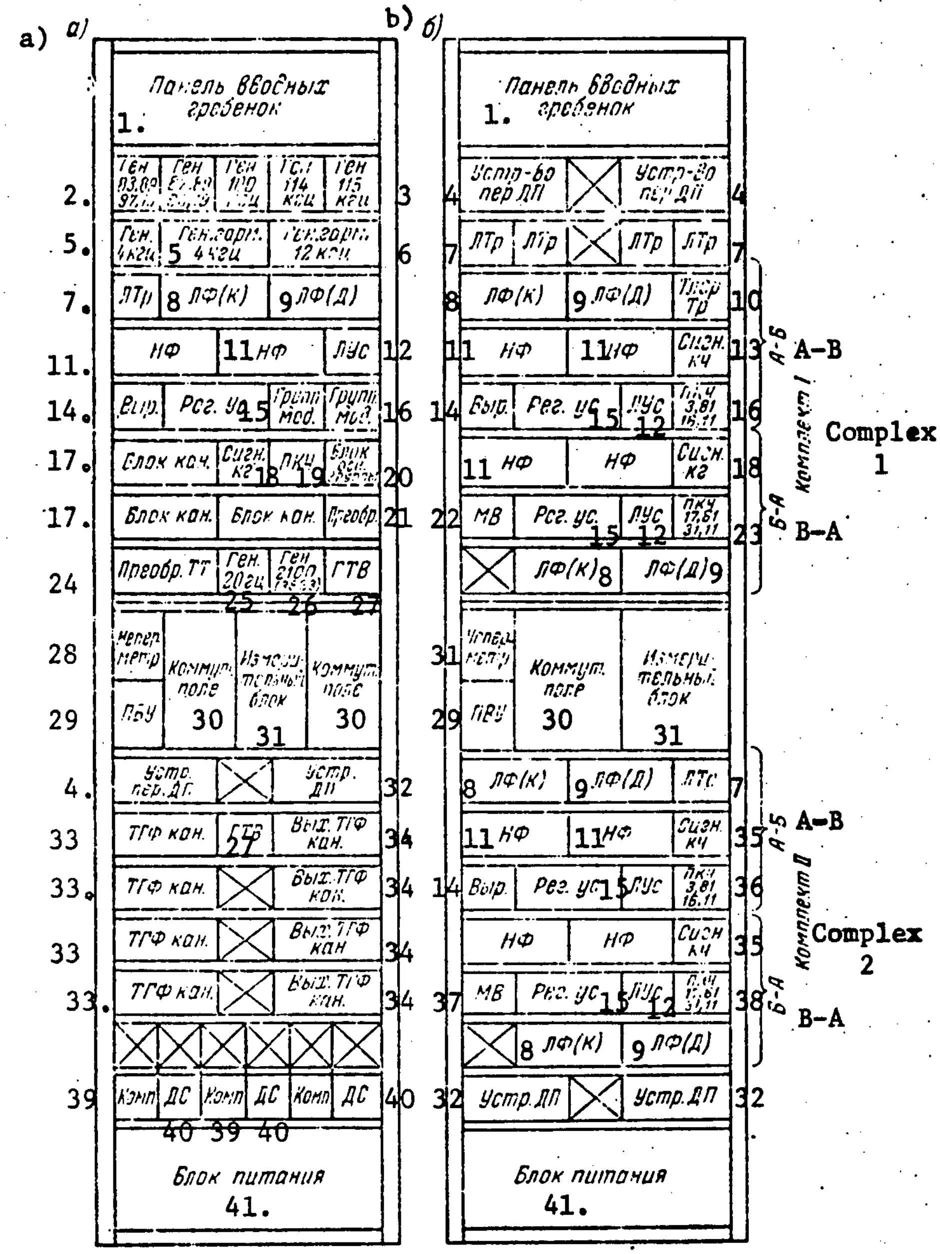


Рис. III.5.3. Размещение оборудования на стойке оконечной (а) и промежуточной (б) станций аппаратуры БО-3-2

Figure 3.5.3. Placement of the equipment in the terminal rack (a) and intermediate rack (b) of the stations of BO-3-2 equipment.

Key:
1. panel of input terminal blocks;
2. 83.89, 97.19 kHz generator;
3. 115 kHz generator;
4. remote power transmit unit;
5. 4 kHz generator;
6. 12 kHz harmonic generator;

[Key to Figure 3.5.3, continued]:

7. Line transformer;
8. Line filter (K);
9. Line filter (D);
10. Telegraph transformer;
11. Routing filters;
12. Line amplifier;
13. control frequency signaling;
14. Equalizer;
15. Gain control;
16. Group modulator;
17. Channel block;
18. Control frequency signaling;
19. Control frequency receiver;
20. Main group block;
21. Converter;
22. MV [expansion unknown];
23. 17.61, 31.11 control frequency receiver;
24. Voice frequency telegraphy converter;
25. 20 Hz generator;
26. 2,100 (3,823) Hz generator;
27. Voice frequency ring generator;
28. Neper meter;
29. Intercom-callup unit;
30. Jack field;
31. Measurement block;
32. Remote power supply unit;
33. Telegraphy channel;
34. Telegraphy channel output;
35. Control frequency signaling;
36. 3.81, 16.11 KHz control channel receiver;
37. MV;
38. 17.81. 31.11 KHz control channel receiver;
39. Compander;
40. Differential system;
41. Power supply block.

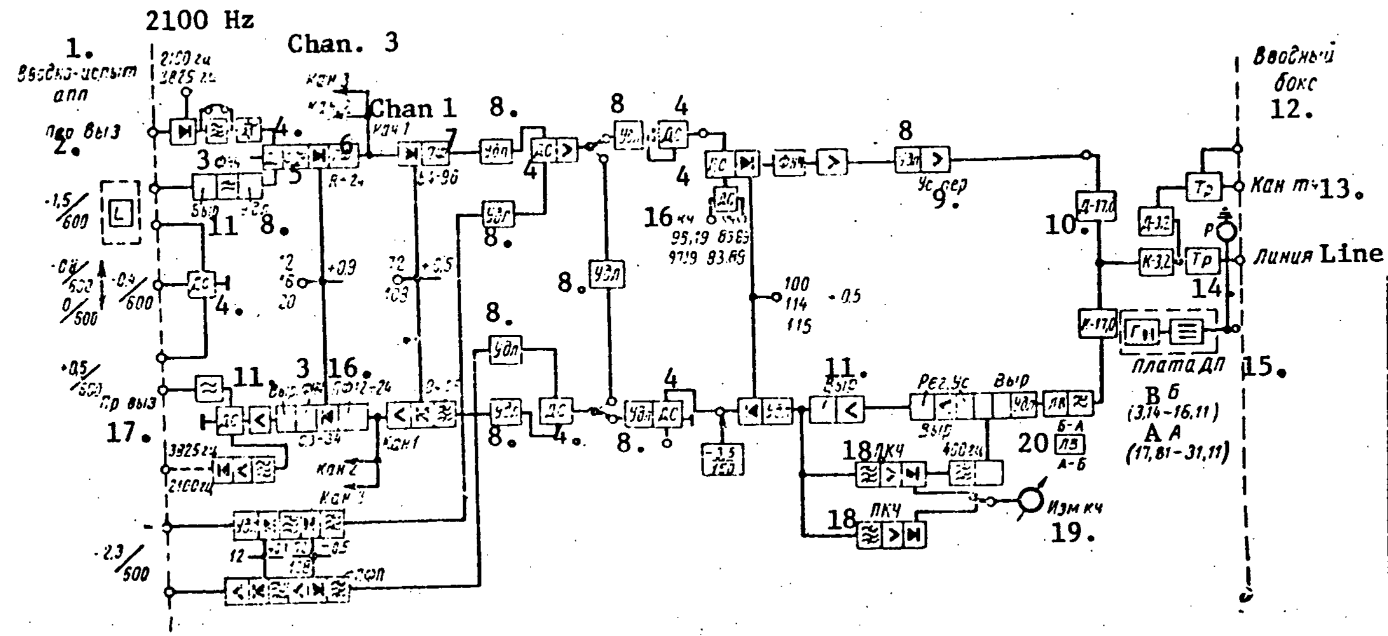


Рис. III.5.4. Блок-схема оконечной станции аппаратуры БО-3-2

Figure 3.5.4. Block diagram of the terminal station of the BO-3-2 equipment.

Key:
1. Input-test set;
2. Ring transmission;
3. FNCh [low pass filter];
4. DS [differential system];
5. [?FVCh? - high pass filter];
6. R-24 PF [R-24 type bandpass filter];
7. 84 - 96 KHz bandpass filter;
8. Pad;
9. Transmit amplifier;
10. D-17.0 filter;
11. Vyr [Equalizer];
12. Input box;
13. Voice frequency channel;
14. Transformer;
15. Remote power unit board;
16. PF 12 - 24 [12 - 24 KHz bandpass filter];
17. Ring receive;
18. Control channel receiver;
19. Control frequency meter;
20. LV [?line equalizer?].

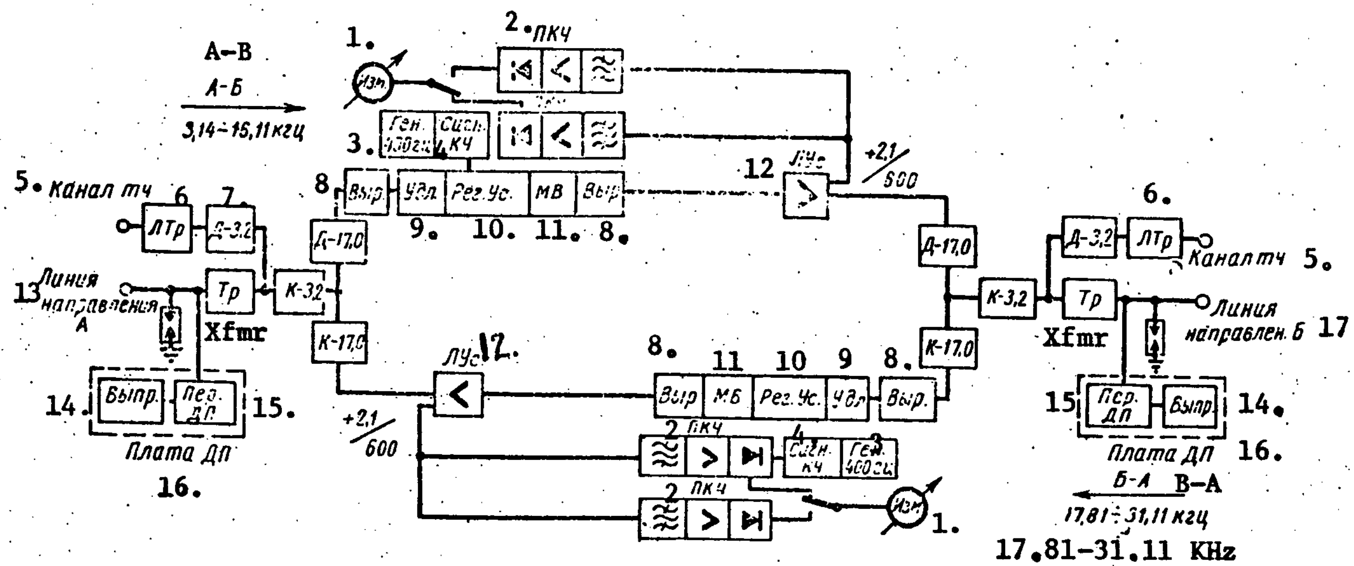


Рис. III.5.5. Блок-схема обслуживаемой усилительной станции аппаратуры БО-3-2

Figure 3.5.5. Block diagram of the attended repeater station of the BO-3-2 equipment.

Key:
1. Meter;
2. Control frequency receiver;
3. 400 Hz generator;
4. Control frequency signaling;
5. Voice frequency channel;
6. Line transformer;
7. D-3.2 filter;
8. Equalizer;
9. Pad;
10. Gain control;
11. MV [expansion unknown];
12. Line amplifier;
13. Line in direction A;
14. Equalizer;
15. Remote power transmit unit;
16. Remote power supply board;
17. Line in direction B.

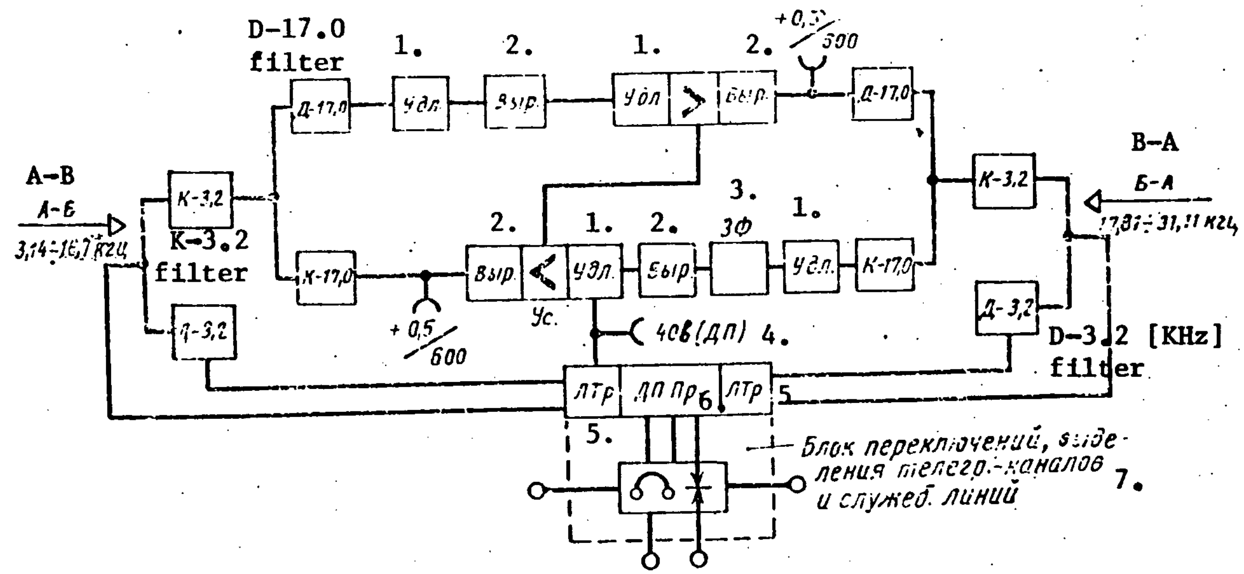


Рис. III.5.6. Блок-схема необслуживаемой станции аппаратуры БО-3-2

Figure 3.5.6. Block diagram of the unattended station of the BO-3-2 equipment.

Key:
1. Pad;
2. Equalizer;
3. ZF [suppression filter];
4. 40 volts (remote power);
5. Line transformer;
6. Remote power receiver;
7. Block for switching, segregating telegraph channels, and service lines.

3.6. The V-12 and V-12-2 Twelve-Channel Transmission Systems (The V-12 equipment has been taken out of production).

Figure 3.6.1. - 3.6.20.

Purpose: Intended for multiplexing open wire, nonferrous metal circuits. The V-12-2 equipment has the same characteristics as the V-12 equipment, being a variant of it.

Type of Line Used: Open wire copper or bimetal circuits with three to four mm diameter conductors.

Communications System: Two-band, electrically four-wire, physically two-wire.

Electrical Characteristics:

The line frequency spectrum — 36 - 143 KHz

1. Варианты линейного спектра	2. Нижняя группа частот, *кгц* (направление передач *Б—А*)	3. Верхняя группа частот, *кгц* (направление передач *А—Б*)
I (1—1)	36÷84 (п)	92÷140 (о)
II (2—1)	36÷84 (о)	95÷143 (п)
III (1—2)	36÷84 (п)	93÷141 (п)
IV (2—2)	36÷84 (о)	94÷142 (о)

Key: 1. Line spectrum variants;
2. Lower group of frequencies, KHz (B-A transmission direction);
3. Upper group of frequencies, KHz (A-B transmission direction);

Notes: 1. Different spectra should be employed on parallel circuits;
2. The standard channel configuration is indicated with п, and the inverse with о.

Secondary multiplexing capability for HF channels	See the introduction
Number of channels which can be organized	12
The effectively transmitted passband	300 - 3,400 Hz
Maximum communications range	10,000 km
Maximum length of a retransmission section	2,000 km
Maximum number of retransmission sections	5
Number of points for the segregation of four channels at attended repeaters in one retransmission section	2
Nominal relative transmit level at the output of terminal and intermediate stations	+2.0 Np

Nominal relative voice frequency levels:		
At the input to the four-wire section of a channel	-1.5 Np	
The same, at the output	+0.5 Np	
At the input and output of the two-wire section of a channel	-0.8 or 0.0 Np	
Channel stability over one retransmission section	0.6 Np	
Maximum gain of the terminal and intermediate stations at the following frequencies:	V-12, Np	V-12-2, Np
84 KHz	5.3 (B-A)	5.65 (B-A)
143 KHz	9.1 (A-B)	8.0 (A-B)

The nonlinearity attenuation of the line amplifier at a transmit level at the output of 2.0 Np for the following harmonics:	
a_{2h}	8.5 Np
a_{3h}	10.0 Np
The nonlinear distortion factor in the channel (one retransmission section):	
V-12	2%
V-12-2	1.5%
The input impedance of the group section of the equipment	135 ohms
The input impedance of the equipment from the exchange and line ends	600 ohms
The design frequencies for noise calculation	83.7 and 143.0 KHz
The AGC system	Electromechanical, two-frequency type
The AGC control frequencies in the line and at the intermediate stations:	
sloped control	40 and 143 KHz
flat control	80 and 92 KHz
The psophometric internal noise voltage in the channels of the terminal stations at the point with a relative level of -0.8 Np	0.3 mv
Voice frequency ringing in the channels:	
V-12	100/20 or 500/20
V-12-2	2,100 Hz

The maximum gain of the auxiliary amplifier stations, at the following frequencies:	VUS-12, Np	VUS-12-2, Np
36 KHz	2.0	1.2
84 KHz	4.7	3.7
92 KHz	5.2	4.2
143 KHz	7.5	6.5

The nominal transmit level:	
VUS-12	+0.5 Np
VUS-12-2	+1.3 Np

The average length of a repeater section, for:

VUS-12 on a 4 mm copper circuit with 25 mm rime ice	50 - 55 km
VUS-12-2	58 - 62 km, under the same conditions

Climatic Operational Conditions:

OP, OUP: At temperatures of from +10 to +40° C, and a relative humidity of 75%.

VUS: At temperatures of from +5 to +40° C, and a relative humidity of 80% at +20° C. A humidity of 95% is permitted for a short time at t = 25° C.

Electrical Power Supply:

Voltages:	Plate	220 volts (unregulated) or 206 volts (regulated)
	Filament and signaling	24 volts unregulated or 21.2 volts (regulated)
	For the AGC motors	127/220 volts AC
	Remote power:	
	VUS-12	160 volts
	VUS-12-2	140 volts

Current and Power Consumption of the V-12 Equipment:

Расход тока и мощности аппаратуры В-12:

	Оборудование Equipment	206 в стаб. а (1)	220 в нестаб. а (2)	21,2 в стаб. а (3)	24 в нестаб. а (4)	127, 220 в ва (5)
	The OV-12A Station Станция ОВ-12(А)					
SGU	СГУ	0,264	0,264	4,15	5,52	50
SINK	СИНК	0,3	0,3	7,13	9,46	—
SGN	СГН (1-1)	0,22	0,22	2,60	3,44	—
SGN	СГН (1-2; 2-1; 2-2)	0,3	0,3	3,88	5,14	—
	The OV-12(B) Station Станция ОВ-12(Б)					
SGU	СГУ	0,274	0,274	4,48	5,95	50
SINK	СИНК	0,38	0,38	8,45	11,9	—
SGN	СГН (1-1; 1-2; 2-1; 2-2)	0,22	0,22	2,56	3,40	—
	The II S-12 Station Станция IIС-12					
	Основная Main	0,45	0,45	6,08	8,10	50
	Дополнительная Auxiliary	0,45	0,45	6,23	8,25	50

Key:
1. 206 volts, regulated, amps;
2. 220 volts, unregulated, amps;
3. 21.2 volts, regulated, amps;
4. 24 volts, unregulated, amps;
5. 127/220 volts, VA.

Current and Power Consumption of the V-12-2 Equipment:

Equipment	206 v., amps	21.2 v., amps	127/220 v. VA
The OV-12-2 Station			
SGO, with remote power	0.97	10.0	50
SGO, without remote power	0.61	10.0	50
The PS-12-2 Stations			
PS-12-2, with remote power	1.24	5.5	50
PS-12-2, without remote power	0.52	5.4	50

Current consumption of the VUS-12-2 auxiliary repeater station	0.31 amps remote power at 140 volts ± 10%
Current consumption of the VUS-12	0.36 amps remote power at 160 volts

Types of Vacuum Tubes Used:

SGU, SINK, SGN, PS-12	TO-1 and TO-2 (with regulated voltages), or 10Zh12S and 10P12S; TO-3 and TO-4 (for unregulated voltages), or 7Zh12S and 7P12S.
VUS-12	12ZhZL
SGO, PS-12-2	6Zh1PYe, 6PZSYe (10Zh1L for the master oscillator).
VUS-12-2	6Zh1PYe

Equipment Complement:

The V-12 terminal station:

SGU: Rack of group devices. It is put together as a set for one system for the following spectra: SGU-A (1-1 and 1-2), SGU-A (2-1 and 2-2), and SGU-B for each spectrum individually (1-1, 1-2, 2-1, and 2-2).

SGN: Group carriers rack. It supplies the carrier frequencies for 10 12-channel systems and has three types of equipment complements: for one spectrum, SGN (1-1); for two spectra, SGN (1-2, 2-1), and for four spectra, SGN (1-2, 2-1, 1-1 and 2-2).

SINK: Individual carriers and control frequencies rack. It supplies the carrier frequencies for 10 12-channel systems.

OSVK: The terminal high frequency switching rack, OSVK. It has the KPS boards for one to four systems with VUS-12 type matching devices for one to four systems.

SChK, STV, SDS, SIP: For these racks (see sections 1, 7 and 11).

V-12 Intermediate Station:

PS-12: The terminal station. It is put together as a set of two racks for one system.

PS-12: The supplemental station. It is put together as a set of two racks for one system.

PSVK: The intermediate high frequency switching rack. It is put together with KPS boards for 1 - 2 systems, and with boards of VUS-12 type matching devices for 1 - 2 systems.

VUS-12 Auxiliary Amplifier Station:

VUS-12: A station of the old series. It is put together in three cabinets for one system: Cabinet No. 1 is for the amplifier equipment for the upper group of frequencies; Cabinet No. 2 is for the amplifier equipment for the lower group of frequencies; Cabinet No. 3 for the protective cevices and suppression filters, which is put together as an equipment set, in turn, in variants I - XVI, depending on the number and types of suppression filters.

VUS-12m: The modernized station. It differs from the old series VUS-12 in that the amplifiers for both transmission directions are housed in one amplifier equipment cabinet.

VUS-12 equipment assemblies: Installed at intermediate or terminal V-12 stations are the remote power transmit board and the board of remote power transmission chokes.

V-12-2 Terminal Station:

SGO: The group equipment rack. It is put together as a set for one system for station A or B. Each station is designed for one of four frequency spectra (I, II, III and IV). Additionally, each station is supplied by the plant with the generator equipment (SGO) or without the generator equipment (SGUO) (see Tables 3.6.1 and 3.6.2). The generator equipment supplies the control and carrier frequencies for two systems of one of the line spectrum variants. (In all, the SGO racks have 16 equipment complements). On special order, the delivery of the following is stiuplated: the matching units, the PIEL instrument and the row signaling transparency.

SIO-12: The individual equipment rack (see section 7).

The PS-12-2 Intermediate Station:

It is put together as a set for one system. The matching devices, PIEL-3, and transparency are supplied on special order.

The VUS-12-2 Auxiliary Amplifier Station:

It is put together in two cabinets for one system: an amplifier equipment cabinet, and a cabinet of input devices and blocking filters, which in turn, has four equipment complement variants:

TABLE 3.6.1. Panel Installation as a Function of the Spectrum in the SGO V-12-2 (with the generator equipment)

Station Designation	Panel 24	Panel 3	Panel 5	Panel 12	Panel 13	Panel 18	Panel 21	Panel 22	Panel 23	Panel 26
SGO-A-I	-	60-111 KHz GKCh	HF LUS	64-104 KHz PKK	Low freq. RP & Low freq. RN	Rec. A F & E	UGN-2 484	UGN-3 308		Rec. A F & E
SGO-A-II	Rec. 4/5	The same	The same	The same	The same	The same	UGN-2 364	UGN-3 543	PGN-548 /543	The same
SGO-A-III	"	58-109 KHz GKCh	The same	The same	The same	The same	UGN-2 484	UGN-3 541	PGN-268 /541	The same
SGO-A-IV	"	The same	The same	The same	The same	The same	UGN-2 364	UGN-3 308	PGN-316 /306	"
SGO-B-1	-	64-104 KHz GKCh	Low freq. LUS	60-111 KHz PKK	High freq. RN & High RP	F & E Rec. B	UGN-2 484	UGN-3 308	-	F & E Rec. B
SGO-B-II	Rec. 4/5	The same	The same	The same	The same	The same	UGN-2 364	UGN-3 543	PGN-548 /543	The same
SGO-B-III	The same	The same	The same	58-109 KHz PKK	The same	The same	UGN-2 484	UGN-3 541	PGN-268 /541	The same
SGO-B-IV	The same	The same	The same	The same	The same	The same	UGN-2 64	UGN-3 306	PGN-316 /306	The same

Key: LUS = line amplifier;
GKCh = ?control frequency generator?
F & E = filters and equalizers;
PKK = control channel receiver
UGN, PGN = unknown.
RP = ?flat control?
RN = ?slope control?

Table 3.6.2. Installation of the Panels as a Function of the Spectrum in the SGUO of the V-12-2 (without the generator equipment)

Station Designation	Panel 5	Panel 12	Panel 13	Panel 18	Panel 26
SGUO-A-I	HF line amp.	64-104 KHz PKK	Low freq. RP & low freq. RN	Filters & Equalizers trans. A	Filters and equalizers Rec. A
SGUO-A-II	"	"	"	"	"
SGUO-A-III	"	"	"	"	"
SGUO-A-IV	"	"	"	"	"
SGUO-B-I	LF line amp.	60-111 KHz PKK	HF RN & HF RP	Filters & Equalizers trans., B	Filters and equalizers Rec. B.
SGUO-B-II	"	"	"	"	"
SGUO-B-III	"	58-109 KHz PKK	"	"	"
SGUO-B-IV	"	"	"	"	"

Variant A:

Panels of cable couplings and boxes	1 unit
Matching devices with 550:140 autotransformers	4 units
Jackfield	1 unit
ZF-1 [suppression filter]	1 unit
ZF-2 filter, ZF-3 filter	3 units each
ZF-4 filter	1 unit

Variant B:

Panels of cable couplings and boxes	1 unit
Matching devices with 550:180 autotransformers	2 units
Jackfield	1 unit
ZF-1 filter	1 unit
ZF-2 filter, ZF-3 filter	3 units each
ZF-4 filter	1 unit

Variant V:

Panels of cable couplings and boxes	1 unit
Matching devices with 550:140 autotransformers	8 units
Jackfield	1 unit
ZF-1 filter	2 units
ZF-2 filter	5 units
ZF-3 filter	3 units
ZF-4 filter	1 unit

Variant G:

Panels of cable couplings and boxes	1 unit
Matching devices with 550:180 autotransformers	8 units
Jackfield	1 unit
ZF-1 filter	2 units
ZF-2 filter	5 units
ZF-3 filter	3 units
ZF-4 filter	1 unit

Construction:

The terminal and intermediate stations are housed in standard racks with panels located on both sides. The dimensions of the racks are:

SGU	2500 x 646 x 410 mm
SGN	2500 x 646 x 410 mm
SINK	2500 x 646 x 410 mm
OSVK	2500 x 646 x 400 mm
PS-12	2500 x 648 x 380 mm
PSVK	2500 x 646 x 410 mm
SGO	2500 x 648 x 464 mm
PS-12-2	2500 x 648 x 464 mm

The auxiliary amplifier stations have a cabinet type construction with dimensions of: VUS-12: 1573 x 670 x 570 mm, and the VUS-12-2: 1356 x 750 x 330 mm.

Note: The VUS-12-2 is installed on metal clamps 200 mm high, supplied with the equipment.

Weight and Cost

Equipment	Weight, kg	Price, rubles
SGU-A (1-1, 1-2)	250	-
SGU-A (2-1, 2-2)	250	-
SGU-B of any spectrum	250	-
SGN (1-1)	300	-
SGN (1-1, 2-1)	350	-
SGN for all spectra	400	-
SINK	250	-
OSVK KPS-1	300	-
OSVK KPS-2	300	-
OSVK KPS-3	300	-
OSVK KPS-4	300	-
OSVK VUS-1	300	-
OSVK VUS-2	300	-
OSVK VUS-3	300	-
OSVK VUS-4	300	-
PS-12, main	350	-
PS-12, supplemental	350	-
PSVK KPS-1	300	-
PSVK KPS-2	350	-

Weight and Cost, continued:

Equipment	Weight, kg	Price, Rubles
PSVK VUS-1	300	-
PSVK VUS-2	350	-
SGO-A-1	280	2,971
SGO-A-II, III, IV	280	3,158
SGO-B-I	280	2,901
SGO-B-II, III, IV	280	3,081
SGUO-A-I, II, III, IV	260	1,680
SGUO-B-I, II, III, IV	260	1,600
PS-V-12-2	330	2,137
The VUS-12m amplifier equipment cabinet	400	-
The VUS-12m protective devices cabinet	400	-
The VUS-12-2 amplifier equipment cabinet	150	1,622
The VUS-12-2 input equipment cabinet for four copper circuit inputs	200	640
The same, for eight copper circuit inputs	220	829

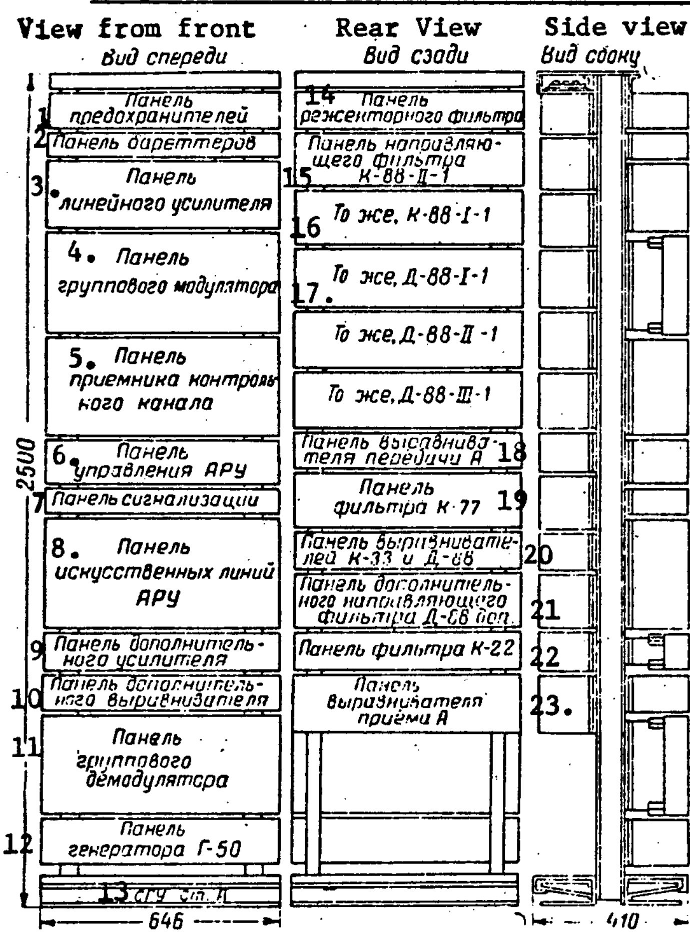


Figure 3.6.1.

Equipment placement in the rack of group devices of station A, SGU-A, of the V-12 equipment.

Key:

1. Fuse panel;
2. Ballast resistor panel;
3. Line amplifier panel;
4. Group modulator panel;
5. Control channel receiver panel;
6. AGC control panel;
7. Signaling panel;
8. AGC phantom line panel;
9. Supplemental amplifier panel;
10. Supplemental equalizer panel;
11. Group demodulator panel;
12. G-50 [50 Hz] generator panel;
13. SGU, station A;
14. Rejection filter panel;
15. K-88-II-1 routing filter panel;
16. The same, K-88-I-1;
17. The same, D-88-I-1;

Key to Figure 3.6.1, continued:

18. Equalizer panel for "A" transmission;
19. K-77 filter panel;
20. K-33 and D-88 equalizer panel;
21. D-88 dop supplemental routing filter panel;
22. K-22 filter panel;
23. Receive "A" equalizer panel.

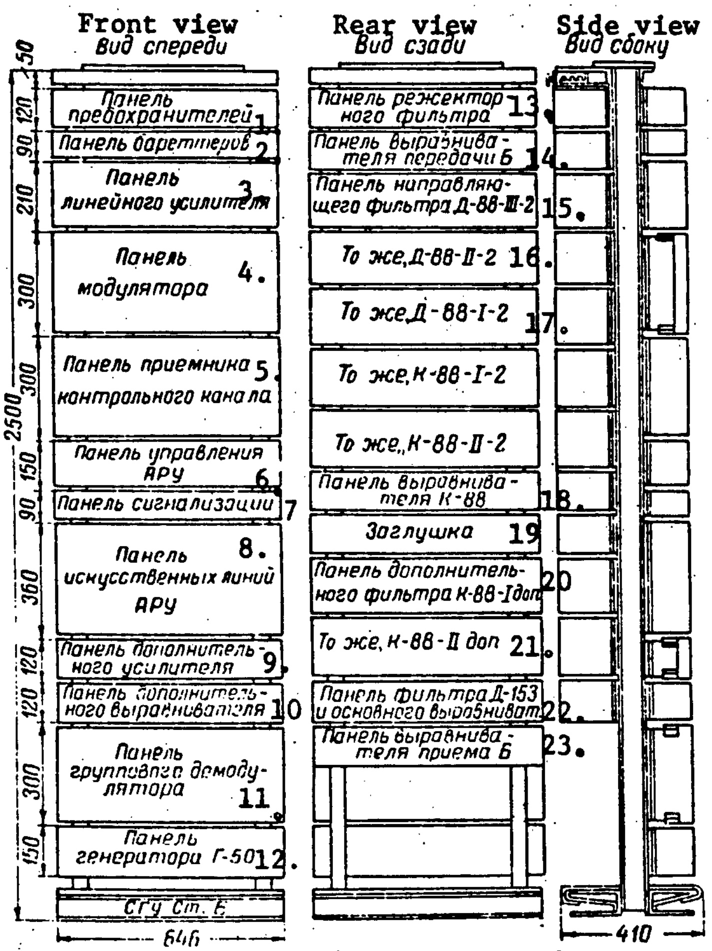


Рис. III.6.2. Размещение оборудования на стойке групповых устройств станции Б СГУ-Б аппаратуры В-12

Figure 3.6.2. Equipment placement in the rack of group devices for station B, SGU-B, of the V-12 equipment.

Key: 1. Panel of fuses;
2. Panel of ballast resistors;
3. Line amplifier panel;
4. Modulator panel;
5. Control channel receiver;
6. AGC control panel;
7. Signaling panel;
8. Panel of phantom lines for the AGC;

[Key to Figure 3.6.2, continued]:

9. Supplemental amplifier panel;
10. Supplemental equalizer panel;
11. Group demodulator panel;
12. G-50 generator panel [50 Hz];
13. Rejection filter panel;
14. B transmit equalizer panel;
15. D-88-III-2 routing filter panel;
16. The same, D-88-II-2;
17. The same, D-88-I-2;
18. K-88 equalizer panel;
19. Blank panel;
20. K-88-I dop supplemental filter panel;
21. K-88-II dop, the same;
22. D-153 and main equalizer panel;
23. B receive equalizer panel.

Key to Figure 3.6.3:

1. Panel of fuses;
2. 308, 340, 424 KHz group carrier amplifier (sepctrum I), main amplifier;
3. RGN-340 KHz signaling and distribution panel (spectrum I);
4. 308, 340 and 584 KHz group carrier amplifier (spectrum I), standby;
5. Rack signaling panel;
6. 60 and 111 KHz control frequency generator (spectra I and II);
7. 364 and 543 KHz group carrier frequency amplifier (spectrum II), main amplifier;
8. 364 and 543 KHz (spectrum II) signaling panel;
9. 364 and 543 KHz (spectrum II) group carrier frequency amplifier, standby;
10. 305 KHz (IV) and 541 KHz (III) group carrier frequency amplifier, main amplifier;
11. 306, 541, 58 and 109 KHz signaling panel;
12. 306 KHz (IV) and 541 KHz (III) group carrier frequency amplifier, standby;
13. 58 and 109 KHz control frequency generator (spectra IV and III);

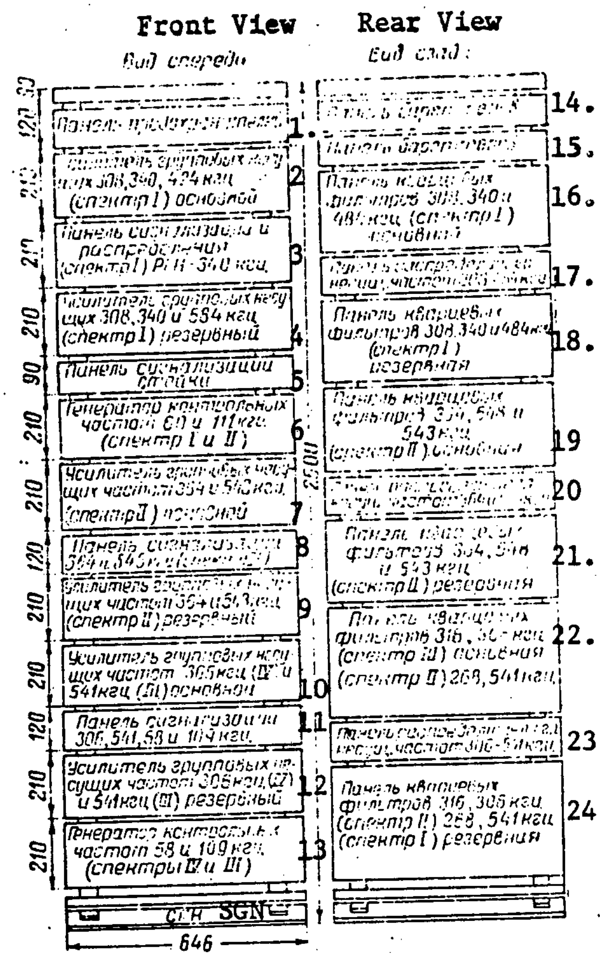


Figure 3.6.3. Equipment placement in the group carrier frequency rack, SGN, of the V-12 equipment.

14. Panel of ballast resistors;
15. Panel of ballast resistors;
16. Panel of 308, 340 and 484 KHz crystal filters (spectrum I), main panel;
17. 308 - 484 KHz group carrier frequency distribution panel;
18. Panel of 308, 340 and 484 KHz crystal filters (spectrum I), standby
19. Panel of 364, 548 and 543 KHz crystal filters (spectrum II), main panel;
20. Distribution panel for the 364 and 543 KHz carrier frequencies;

[Key to Figure 3.6.3, continued]:

21. Panel of the 364, 548 and 543 KHz crystal filters (spectrum II), standby;
22. Panel of the 316 and 306 KHz (spectrum III), main, and 268, 541 KHz (spectrum II) crystal filters;
23. Distribution panel for the 306 - 541 KHz group carrier frequencies;
24. Panel of 316, 306 KHz (spectrum II), and 268, 541 KHz (spectrum I) crystal filters, standby.

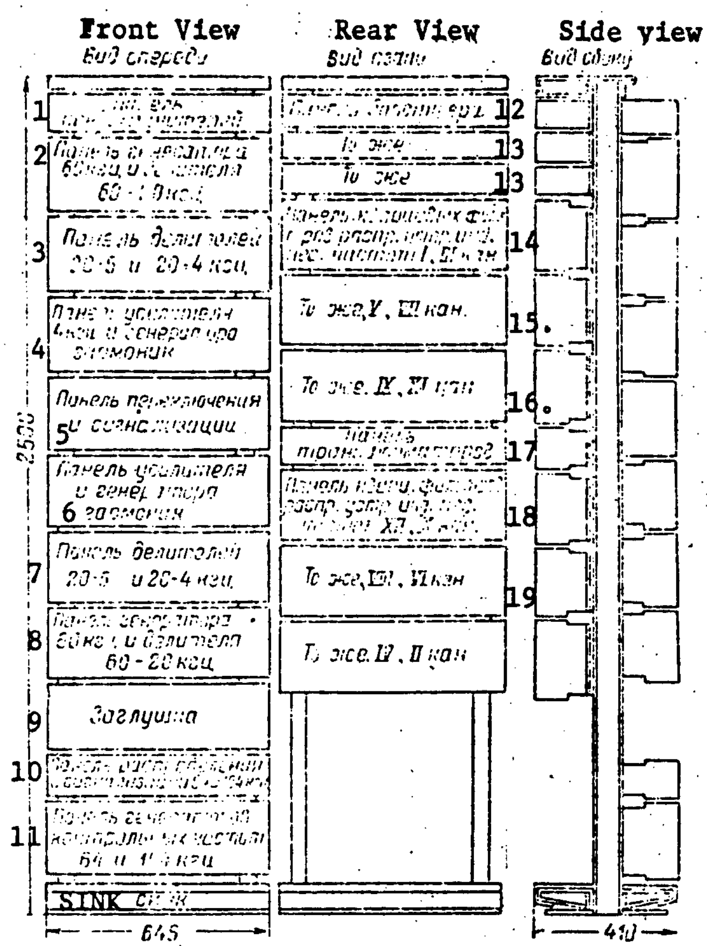


Figure 3.6.4. Equipment placement in the rack for the individual carrier and control frequencies, SINK, of the V-12 equipment.

Key:
1. Panel of fuses;
2. Panel for the 60 KHz and 60 - 20 KHz divider;
3. Panel of 20 - 5 and 20 - 4 KHz dividers;
4. 4 KHz amplifier and harmonic generator panel;
5. Switching and signaling panel;
6. Amplifier and harmonic generator panel;
7. Panel of 20 - 5 and 20 - 4 KHz dividers;
8. 60 KHz generator and 60 - 20 KHz divider panel;
9. Blank panel;
10. 64 and 104 KHz distribution and signaling panel;

[Key to Figure 3.6.4, continued]:

11. Panel of 64 and 104 KHz control frequency generators;
12. Ballast resistor panel;
13. The same;
14. Panel of crystal filters, distribution units of the individual carrier frequencies for I and III channels;
15. The same, channels V, VII;
16. The same, channels IX and XI;
17. Panel of transformers;
18. Panel of crystal filters, distribution devices, and individual carrier frequencies of channels XII and X;
19. The same, channels VII, VI.

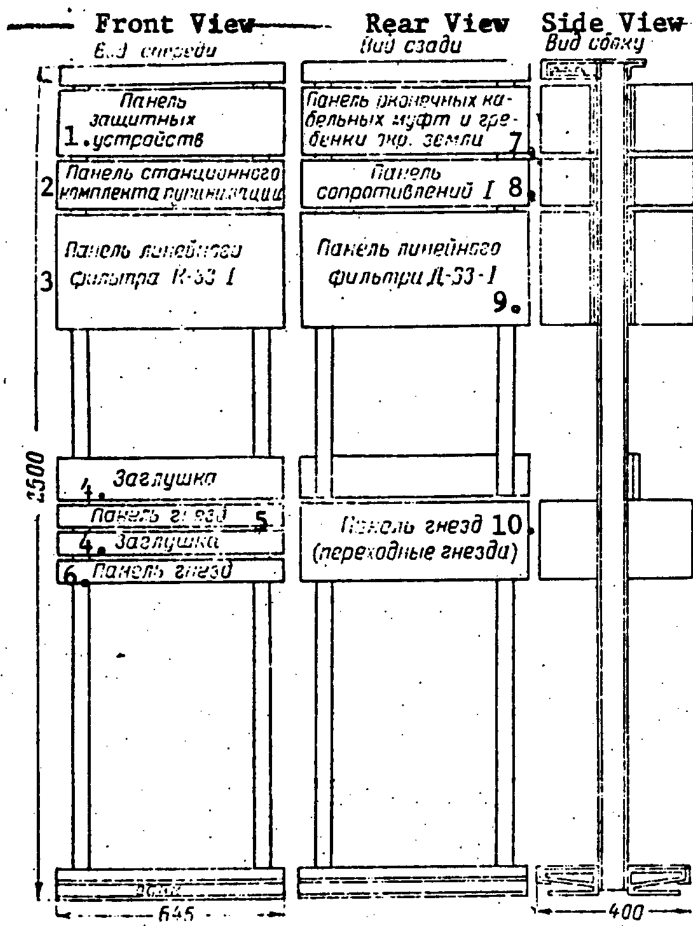


Figure 3.6.5. Equipment placement in the terminal high frequency switching rack, OSVK, of the V-12 equipment.

Key: 1. Panel of protective devices;
2. Panel for the station coil loading complex;
3. K-33-I line filter panel;
4. Blank panel;

[Key to Figure 3.6.5, continued]:

5. Jack panel;
6. Jack panel;
7. Panel of terminal cable couplings and shield ground terminal blocks;
8. Resistor panel I;
9. D-33-I line filter panel;
10. Jack panel (transit jacks).

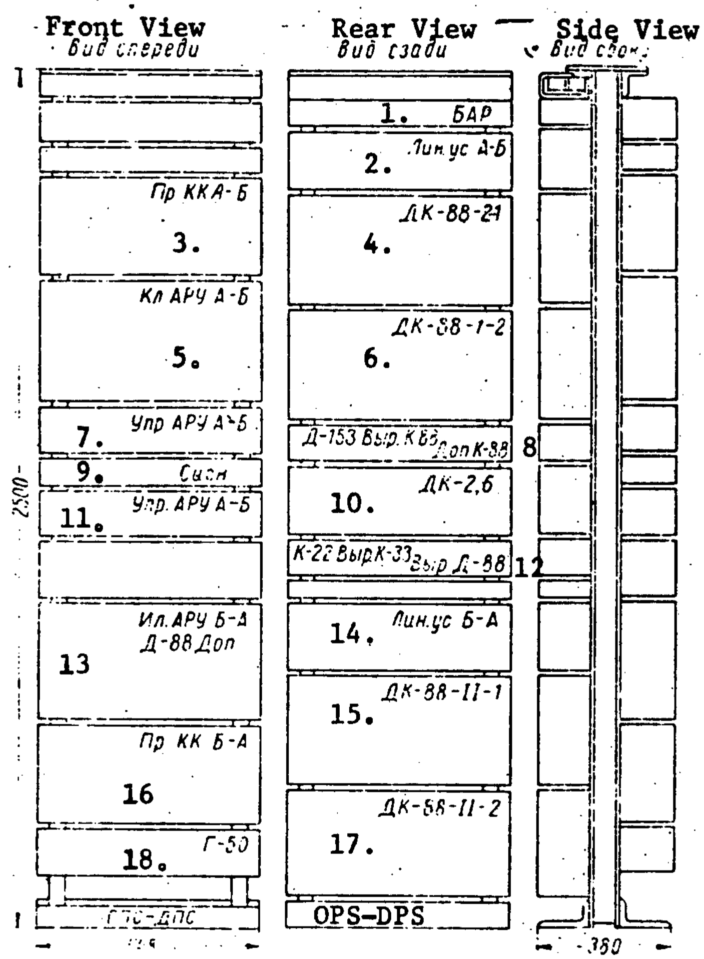


Figure 3.6.6. Equipment placement in the intermediate amplifier equipment rack, OPS or DPS, of the V-12 equipment.

Key:
1. BAR [expansion unknown];
2. A-B line amplifier;
3. A-B control channel receiver;
4. DK-88-2-1 filter;
5. A-B AGC monitor panel;
6. DK-88-1-2 filters;
7. A-B AGC control panel;
8. D-153 equalizer, K-88, and supplemental K-88 filter;
9. Signaling;
10. DK-2.6 filter;
11. A-B AGC control;
12. K-22 Equalizer, K-33, D-88 equalizer;
13. B-A AGC Il [?phantom line?]; D-88 dop [D-88 supplemental filter];
14. B-A line amplifier;
15. DK-88-II-1 filter;
16. B-A control channel receiver;
17. DK-88-II-2 filter
18. G-50 [50 Hz generator];

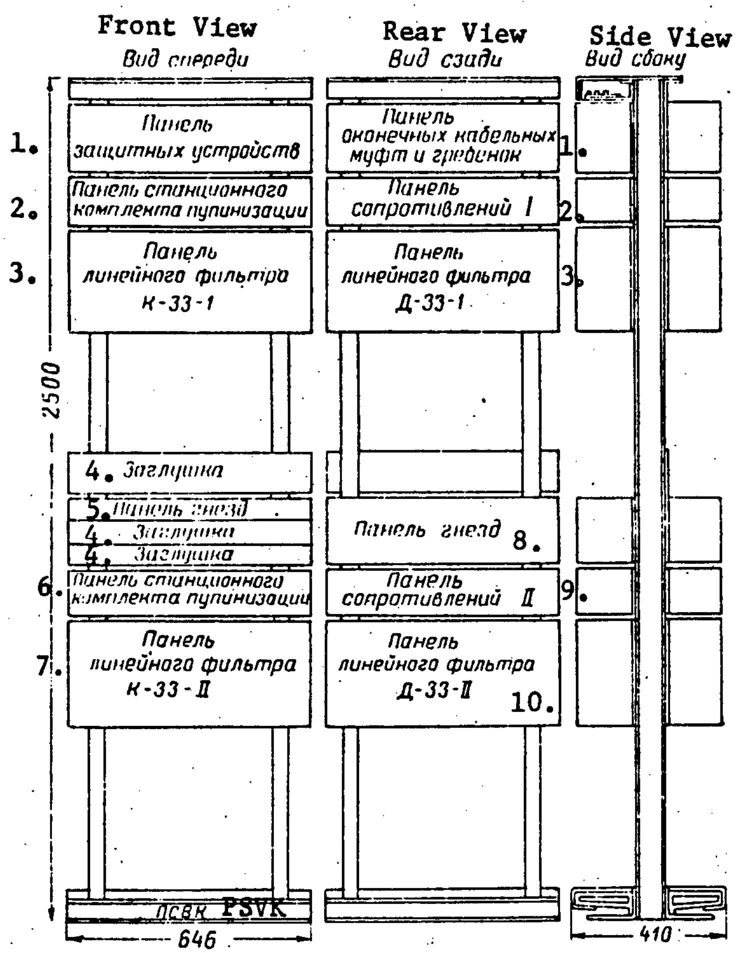


Figure 3.6.7. Equipment placement in the intermediate high frequency switching rack, PSVK, of the V-12 equipment.

Key: 1. Panel of protective devices;
2. Panel of the station coil-loading complex;
3. K-33-1 line filter panel;
4. Blank panel;
5. Jack panel;
6. Panel of the station coil-loading complex;
7. K-33-II line filter panel;
8. Jack panel;
9. Resistor panel II;
10. D-33-II line filter panel.

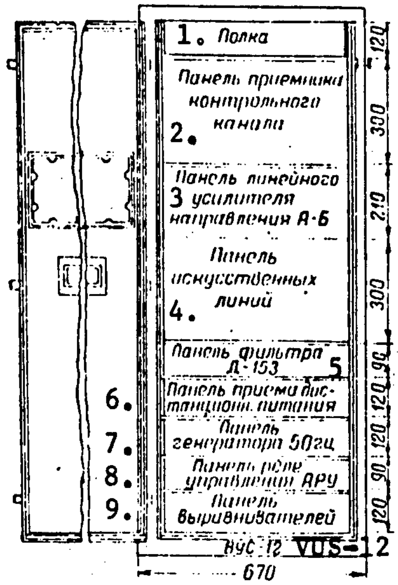


Figure 3.6.8. Placement of the cabinet equipment with the amplifier for the A-B direction of the VUS-12 equipment (cabinet No. 1).

Key: 1. Shelf;
2. Control channel receiver panel;
3. A-B direction line amplifier panel;
4. Panel of phantom lines;
5. D-153 filter panel;
6. Remote power reception panel;
7. 50 Hz generator panel;
8. Panel of AGC control relays;
9. Panel of equalizers;

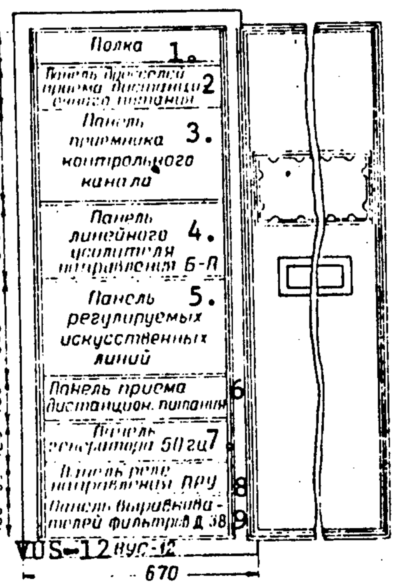


Figure 3.6.9. Placement of the cabinet equipment with the amplifier for the B-A direction of the VUS-12 equipment (cabinet No. 2).

Key: 1. Shelf;
2. Panel of chokes for remote power reception;
3. Control channel receiver panel;
4. B-A direction line amplifier panel;
5. Panel of adjustable phantom lines;
6. Remote power reception panel;
7. 50 Hz generator panel;
8. AGC direction relay panel;
9. Panel of D-38 equalizers-filters.

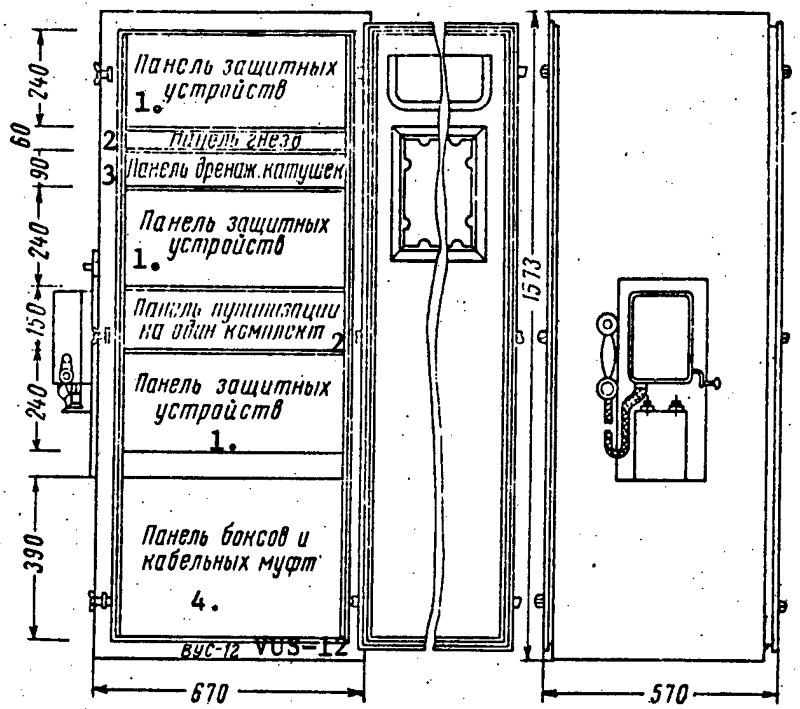


Рис. III.6.10. Размещение оборудования шкафа защитных устройств и запирающих фильтров аппаратуры ВУС-12 (шкаф № 3)

Figure 3.6.10. The placement of the equipment of the cabinet of protective devices and blocking filters of the VUS-12 equipment (cabinet No. 3).

Key:

1. Panel of protective devices;
2. Jack panel;
3. Panel of bleeder coils;
4. Panel of boxes and cable couplings.

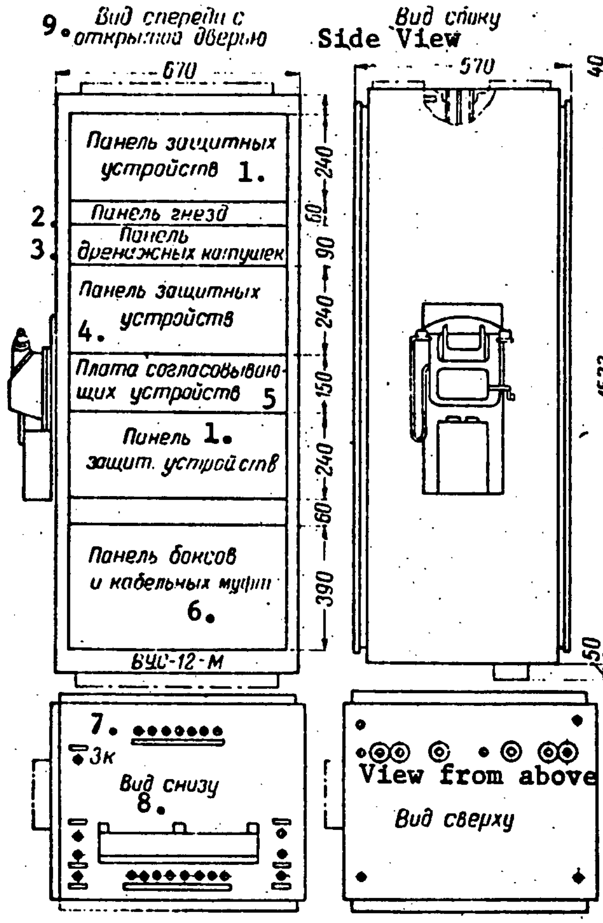


Figure 3.6.11. The placement of the equipment of the cabinet of protective devices and blocking filters of the VUS-12m equipment.

Key:
1. Panel of protective devices;
2. Jack panel;
3. Panel of bleeder coils;
4. Panel of protective devices;
5. Panel of matching devices;
6. Panel of boxes and cable couplings;
7. Zk [?channel ground?];
8. View from below;
9. View from the front with the door open.

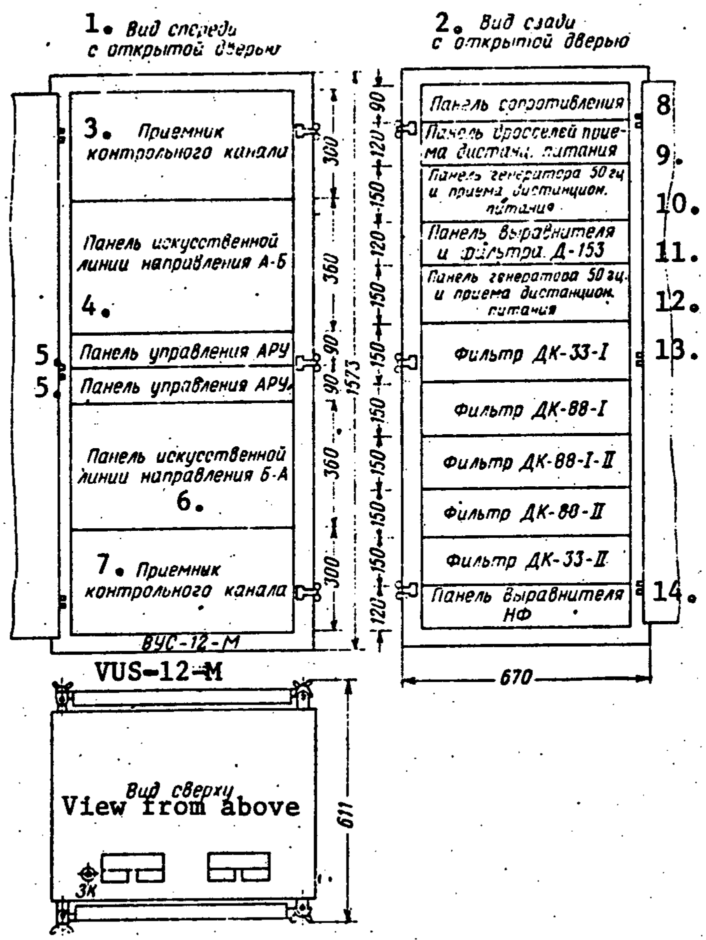


Figure 3.6.12. The placement of the equipment of the amplifier cabinet of the VUS-12m equipment.

Key: 1. View from the front with the door open;
2. View from the rear with the door open;
3. Control channel receiver;
4. Phantom line panel for the A-B direction;
5. AGC control panel;
6. Phantom line panel for the B-A direction;
7. Control channel receiver;
8. Resistor panel;
9. Panel of chokes for remote power reception;
10. 50 Hz generator and remote power reception panel;
11. Equalizer and D-153 filter panel;
12. 50 Hz generator and remote power reception panel;
13. DK-33-I filter;
14. Equalizer, routing filter panel.

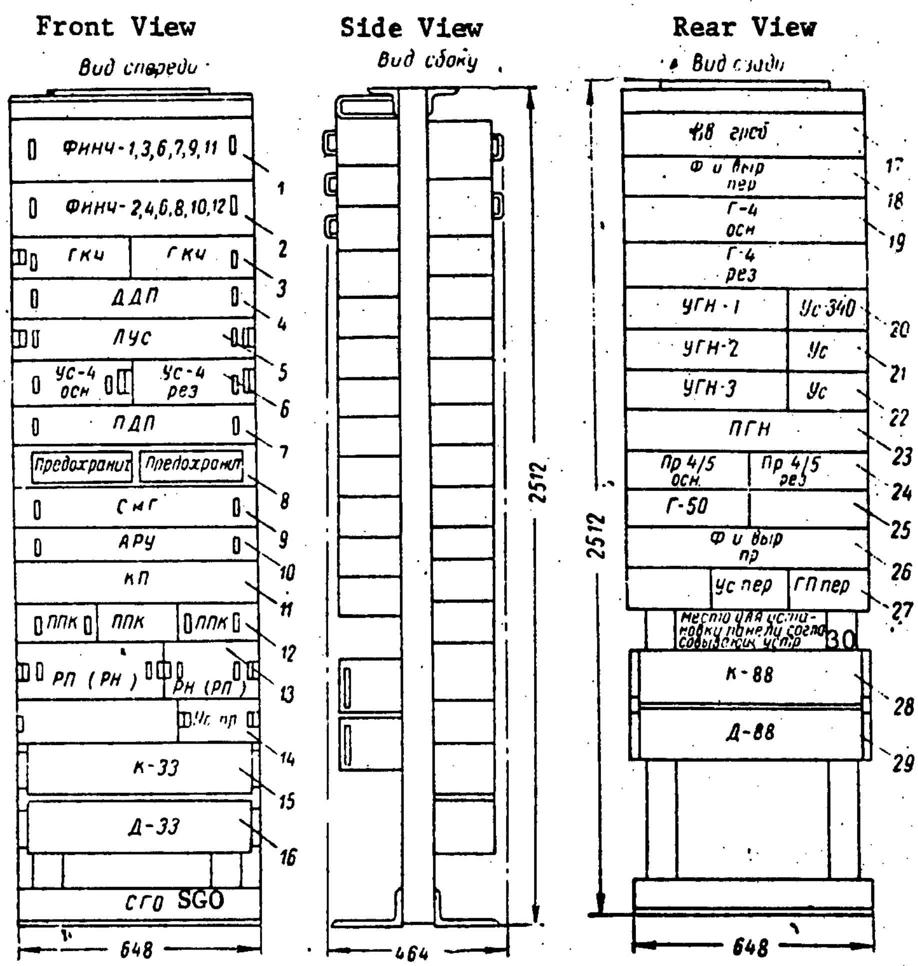


Figure 3.6.13. The placement of the equipment in the group equipment rack, SGO, of the V-12-2 equipment (with the generator equipment). See Table 3.6.1. for the equipment complement.

Key:

1. FINCh [individual carrier frequency filters]: 1, 3, 6, 7, 9, 11;
2. FINCh: 2, 4, 6, 8, 10, 12;
3. Control frequency generator;
4. DDP [?remote power supply chokes?];
5. Line amplifier;
6. Us-4 OSN [main 4 KHz amplifier]; Us-4 REZ [standby 4 KHz amplifier];
7. PDP [?remote power supply transmit unit?];
8. Fuses;
9. SIG [?signaling?];
10. AGC;
11. Jackfield;
12. PPK [expansion unknown];

[Key to Figure 3.6.13]:

13. RP [?flat control?] (RN) [?slope control?];
14. Receive amplifier;
15. K-33 filters;
16. D-33 filters;
17. Input terminal blocks;
18. Transmit filters and equalizers;
19. Main G-4 generator;
20. Us-340 [?340 KHz amplifier?];
21. Amplifier;
22. Amplifier;
23. PGN [expansion unknown];
24. Pr 4/5 Rez [unknown type of backup receiver];
25. G-50 [50 Hz generator];
26. Receive filters and equalizers;
27. GP per [?transmit group converter?];
28. K-88 filters;
29. D-88 filters;
30. Place for the installation of the panel of matching devices.

[Key to Figure 3.6.14, see following page 188]:

4. DDP [?remote power chokes?];
5. Line amplifier
7. PDP [?remote power transmitter?];
8. Pr [receivers];
9. SIG [?signaling?];
10. Automatic gain control;
11. KP [expansion unknown];
12. PKK [control channel receiver];
13. RP - (RN) [?flat contro? (?slope control?];
14. USPR [expansion unknown];
15. K-33 filters;
16. D-33 filters;
17. Input terminal blocks;
18. Transmit filters and equalizers;
25. G-50 [50 Hz generator];
26. Receive filters and equalizers;
27. GP per [?transmit group converter?];
28. K-88 filters;
29. D-88 filters;
30. Place for the installation of the panel of matching devices.

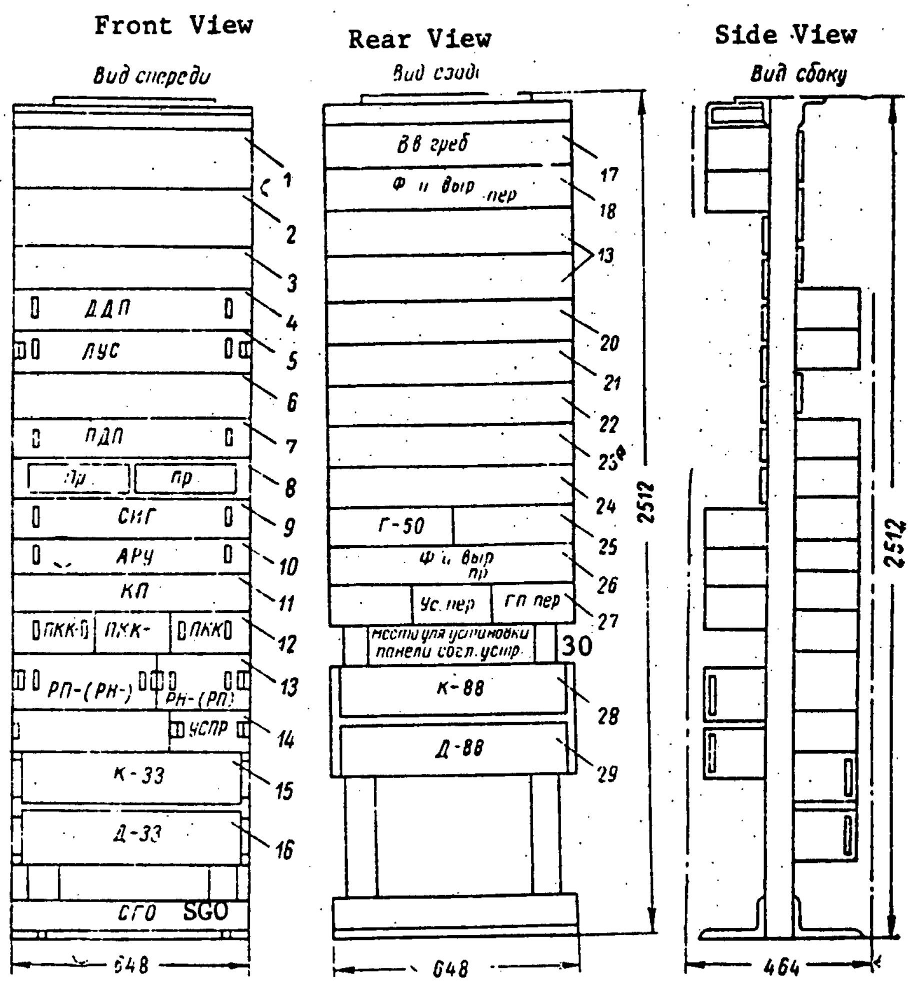


Рис. III.6.14. Размещение оборудования на стойке группового оборудования СГУО аппаратуры В-12-2 (без ген. оборудования). Комплектацию см. в табл. III.6.2

Figure 3.6.14. The placement of the equipment in the group equipment rack, SGUO, of the V-12-2 equipment (without the generator equipment). See Table 3.6.2 for the equipment complement.

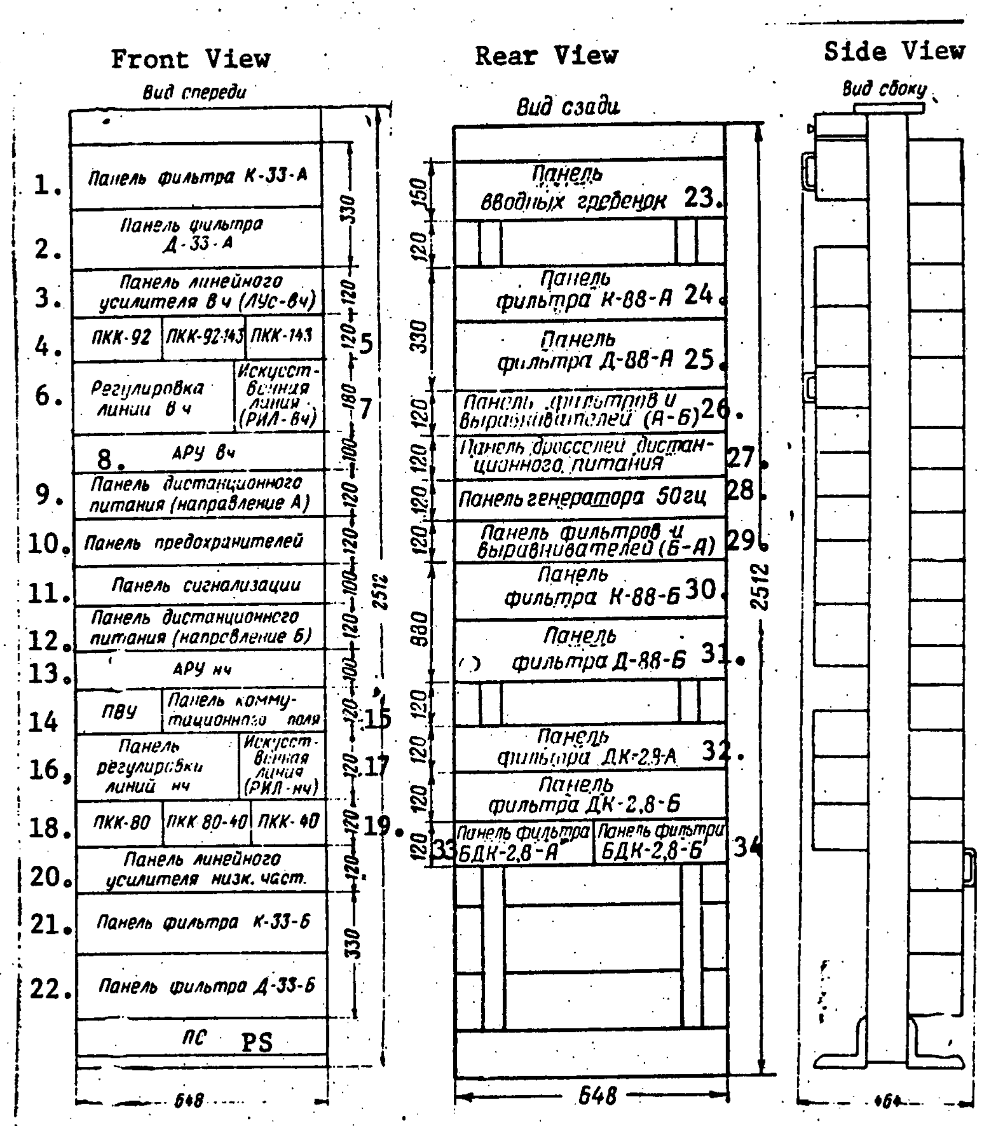


Figure 3.6.15. The placement of the equipment in the intermediate station rack, PS, of the V-12-2 equipment.

Key:
1. K-33-A filter panel;
2. D-33-A filter panel;
3. High frequency line amplifier panel (LUs-VCh);
4. 92 KHz control channel receiver;
5. 143 KHz control channel receiver;
6. High frequency line adjustment;
7. Phantom line (RIL-VCh) [high frequency phantom line adjustment];
8. High frequency AGC;
9. Remote power supply panel (direction A);
10. Panel of fuses;
11. Signaling panel;

[Key to Figure 3.6.15, continued]:

12. Remote power panel (direction B);
13. Low frequency AGC;
14. Intercom-callup unit;
15. Jackfield panel;
16. Panel for the adjustment of the low frequency lines;
17. Phantom line (RIL-NCh) [(Low frequency phantom line adjustment)];
18. 80 KHz control channel receiver;
19. 40 KHz control channel receiver;
20. Low frequency line amplifier panel;
21. K-33-B filter panel;
22. D-33-B filter panel;
23. Panel of input terminal blocks;
24. K-88-A filter panel;
25. D-88-A filter panel;
26. Panels of filters and equalizers (A-B);
27. Panel of remote power supply chokes;
28. 50 Hz generator panel;
29. Panel of filters and equalizers (B-A);
30. K-88-B filter panel;
31. D-88-B filter panel;
32. DK-2.8-A filter panel;
33. BDK-2.8-A filter panel;
34. BDK-2.8-B filter panel;

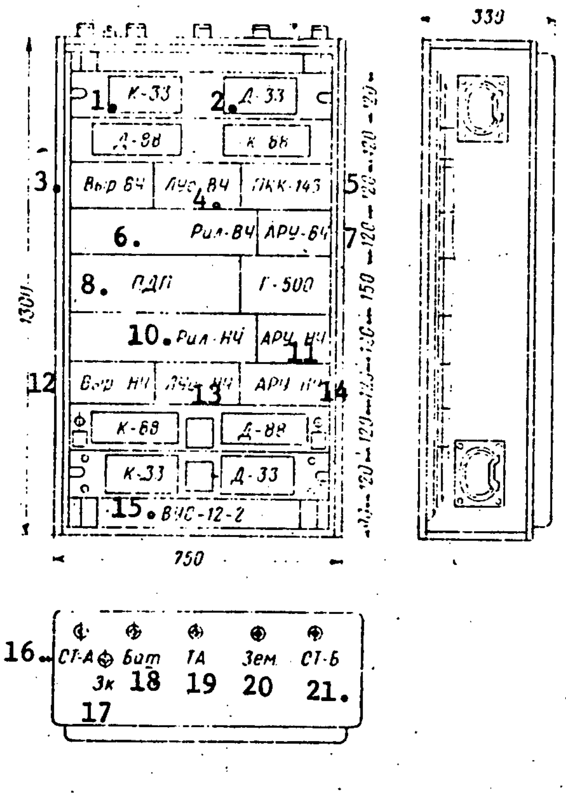


Figure 3.6.16. The placement of the equipment in the amplifier equipment cabinet of the VUS-12-2 equipment.

Key:
1. K-33 filter;
2. D-33 filter;
3. High frequency equalizer;
4. High frequency line amplifier;
5. 143 KHz control channel receiver;
6. High frequency phantom line adjuster;
7. High frequency AGC;
8. PDP [?remote power transmit unit?];
9. G-500 [500 Hz oscillator];
10. Low frequency phantom line adjuster;
11. Low frequency AGC;
12. Low frequency equalizer;
13. Low frequency line amplifier;
14. Low frequency AGC;
15. VUS-12-2;
16. ST-A [station A];
17. Zk [?cable ground?];
18. Bat [battery];
19. TA [?telephone set?];
20. Ground;
21. Station B.

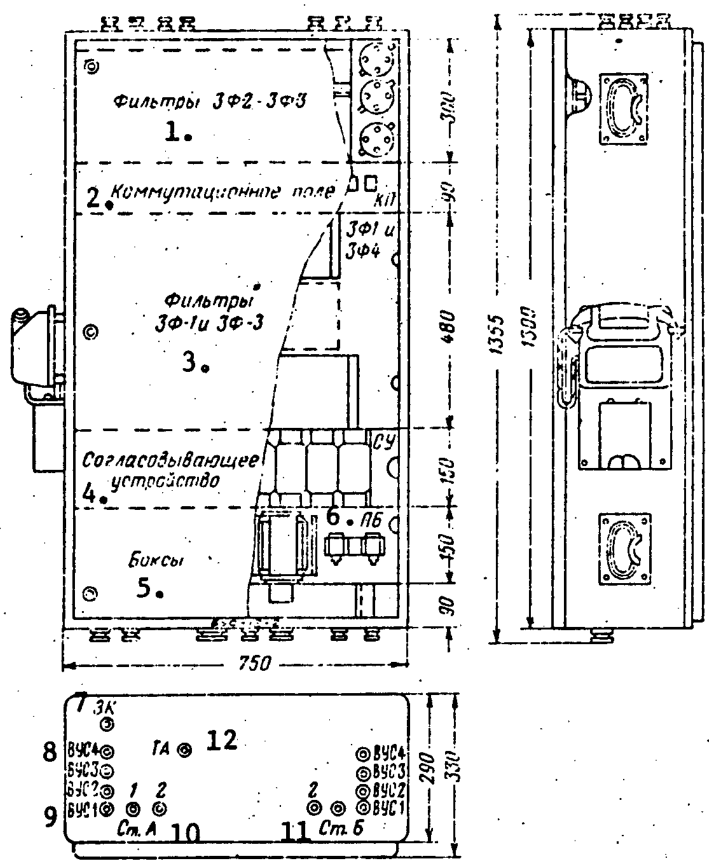


Figure 3.6.17. The placement of the equipment in the input equipment cabinet of the VUS-12-2 equipment.

Key: 1. ZF-2 — ZF-3 [suppression] filters;
2. Jackfield;
3. ZF-1 and ZF-3 filters;
4. Matching unit;
5. Boxes;
6. PB [expansion unknown];
7. ZK [?cable ground?];
8. VUS-4 [auxiliary amplifier station 4];
9. VUS-1;
10. Station A;
11. Station B;
12. TA [?telephone set?].

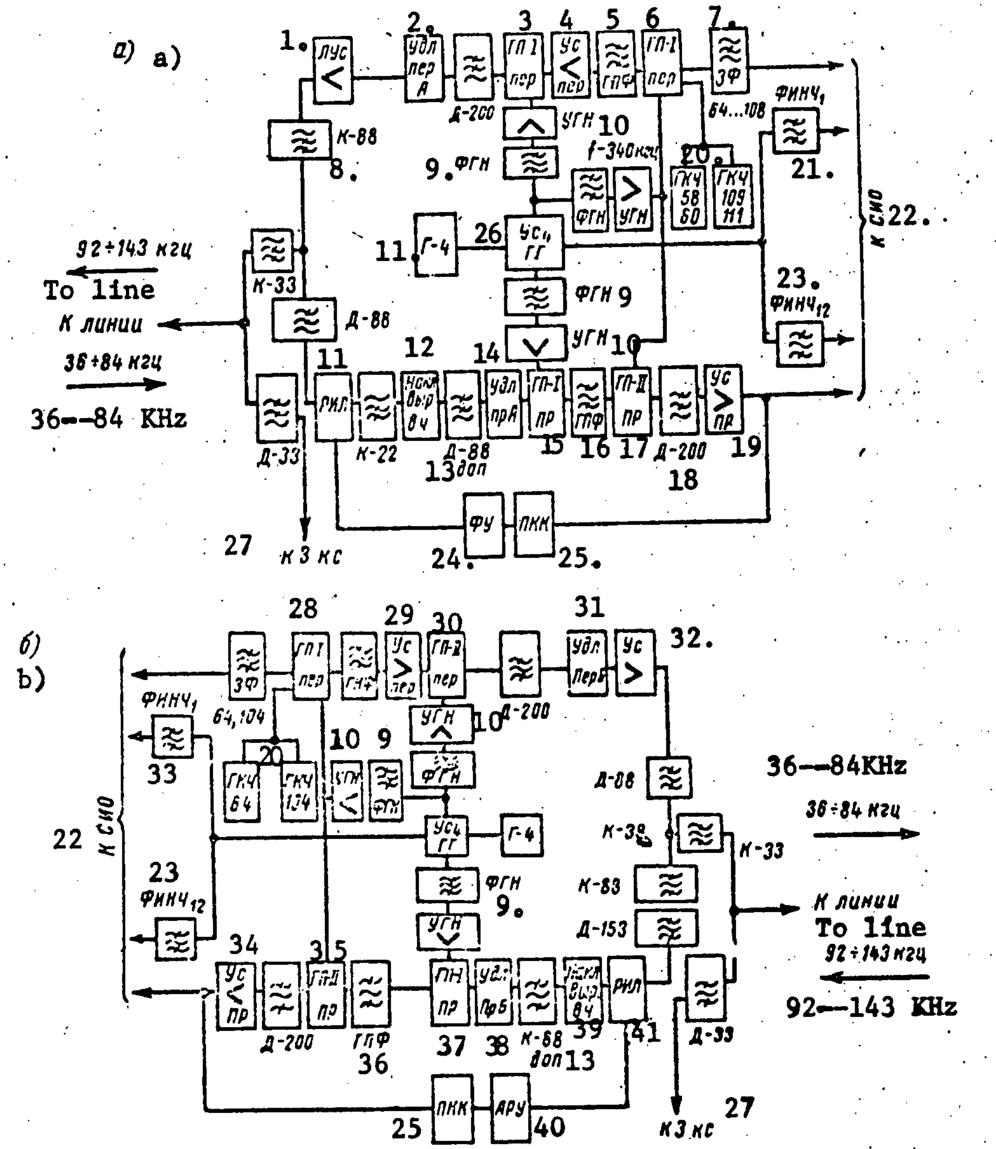


Figure 3.6.18. Block diagrams of the terminal stations of the V-12-2 equipment: a) SGO-A; b) SGO-B.

Key: 1. Line amplifier;
2. Transmit A pad;
3. GP-I per [?group converter I, transmit?];
4. Transmit amplifier;
5. GPF [group bandpass filter];
6. GP-I per;
7. ZF [suppression filter];
8. K-88 filter;

[Key to Figure 3.6.18, continued]:

9. FGN [group carrier filter];
10. UGN [group carrier amplifier];
11. G-4 generator;
12. High frequency slope equalizer;
13. Supplemental D-88 filter;
14. Receive A pad;
15. GP-1 Pr [?group converter I, receiver?];
16. GPF [group bandpass filter];
17. GP-II PR;
18. D-200 filter;
19. Us PR [?receive amplifier?];
20. Control frequency generator;
21. $FINCh_1$ [individual carrier frequency filter 1];
22. To the individual equipment bay;
23. Individual carrier frequency filter 12;
24. FU [expansion unknown];
25. Control channel receiver;
26. Us4 GG [amplifier 4, harmonic generator];
27. To 3 channel systems;
28. GP I per [?group converter I, transmit];
29. Transmit amplifier;
30. GP II, per;
31. B transmit pad;
32. Amplifier;
33. $FINCh_1$ [individual carrier frequency filter 1];
34. Receive amplifier;
35. GP-II PR [?group converter II, receiver?];
36. GPF [group bandpass filter];
37. PN, pr [?carrier converter, receive?];
38. B receive pad;
39. Slope type high frequency equalizer;
40. AGC;
41. RIL [phantom line adjuster].

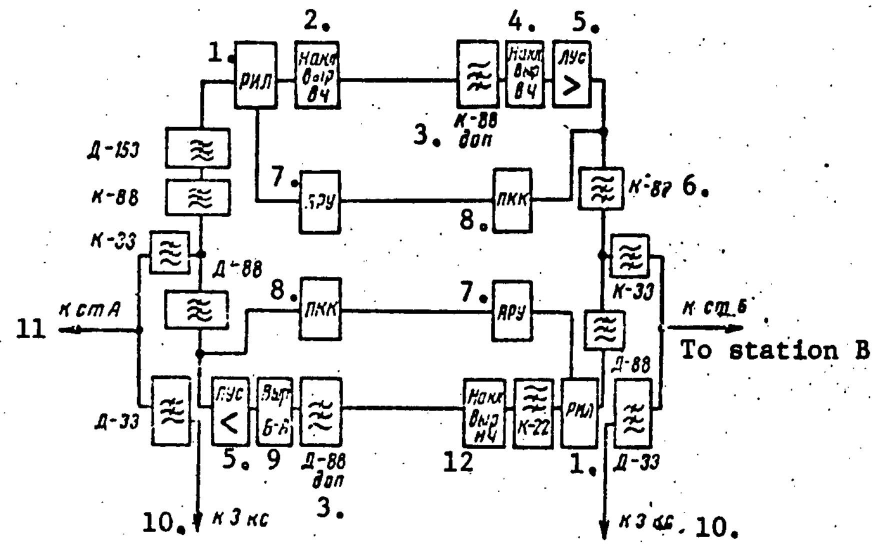


Рис. III.6.19. Блок-схема промежуточной станции ПС-12-2 аппаратуры В-12-2

Figure 3.6.19. Block diagram of the PS-12-2 intermediate station of the V-12-2 equipment.

Key: 1. RIL [phantom line adjuster];
2. Slope type high frequency equalizer;
3. Supplemental K-88 filter;
4. Slope type high frequency equalizer;
5. Line amplifier;
6. K-88 filter;
7. Automatic gain control;
8. Control channel receiver;
9. B-A equalizer;
10. To 3 channel systems;
11. To station A;
12. Slope type low frequency equalizer.

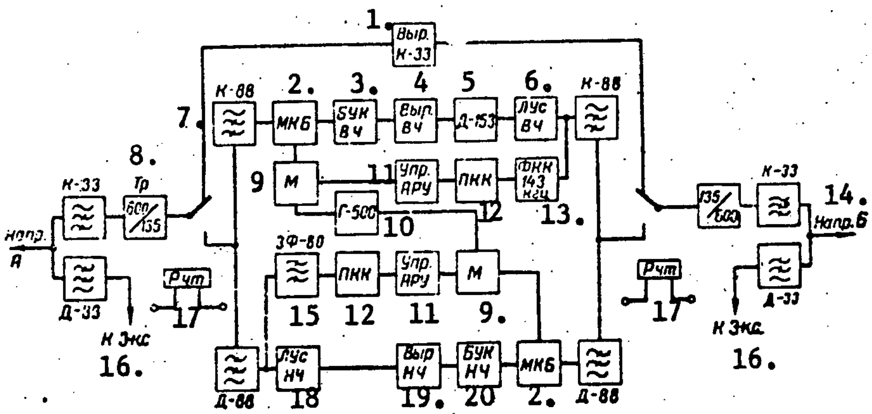


Рис. III.6.20. Блок-схема вспомогательной усилительной станции ВУС-12-2 аппаратуры В-12-2

Figure 3.6.20. Block diagram of the VUS-12-2 auxiliary amplifier station of the V-12-2 equipment.

Key: 1. K-33 equalizer;
2. MKB [expansion unknown];
3. BUK VCh [expansion unknown];
4. High frequency equalizer;
5. D-153 filter;
6. High frequency line amplifier;
7. K-88 filter;
8. 600:135 ohm transmformer;
9. M [?modulator?];
10. 500 Hz generator;
11. AGC control;
12. Control channel receiver;
13. 143 KHz control channel filter;
14. Directtion B;
15. ZF-80 [80 KHz suppression filter];
16. To 3 channel systems;
17. Rchm [expansion unknown];
18. Low frequency line amplifier;
19. Low frequency equalizer;
20. BUK NCh [low frequency BUK].

3.7. The V-12-3 Twelve-Channel Transmission System
Figures 3.7.1 - 3.7.5.

Purpose: Intended for multiplexing open wire circuits.

Type of Line Used: Open wire, copper or bimetal circuits.

Communications System: Two-band, electrically four-wire, physically two-wire.

Electrical Characteristics:

Line frequency spectrum — 36 ÷ 143 KHz

Spectrum Варианты спектра Variants	1. Полоса частот для направления, кгц	
	B-A Б–А	A-B А–Б
I	36÷84 (п) (p)	92÷140 (о)
II	36÷84 (о) (o)	95÷143 (п)
III	36÷84 (п)	93÷141 (п)
IV	36÷84 (о)	94÷142 (о)

Key: 1. Passbands for the following directions, KHz;

Note: The standard arrangement of the channels is indicated with a п, and the inverse with an о.

The capability of secondary multiplexing of the channels	See the introduction
The number of channels which can be organized	12
The effectively transmitted passband	300 - 3,400 Hz
The maximum communications range	10,000 km
The maximum length of a retransmission section (when using OUP's [attended repeater stations] and VUS's [auxiliary amplifier stations])	2,000 km
The maximum length of a repeater section ("25 mm rime ice" weather, and where there are cable inserts and entrances with an overall length of up to 11 km):	
Without a VUS	54 km
One VUS	100 km
Two VUS's	143 km
The maximum number of retransmission sections	5
The nominal relative transmit level at the output of terminal and intermediate stations	+2.0 Np
The nominal relative voice frequency level:	
— The four-wire section of a channel:	
at the input	-1.5 Np

at the output	+0.5 Np
at the input and output of a two-wire section of a channel	-0.4 Np
The nominal value of the relative power level of the terminal station for a group channel:	
at the input	-4.5 Np
at the output	-0.6 Np
The input impedance of terminal and attended stations:	
from the line end	550 ohms
from the station end	600 ohms
The reflection factor from the line end with respect to 550 ohms	10%
The power level of carrier frequency residues at the output of a terminal station:	
for all channels of the system of one transmit direction	< 0.0 Np
for the residues of channel carrier frequencies which coincide with the control frequencies	< -3.0 Np
for group carrier frequencies	< -3.5 Np
The power level of the line control frequencies at the output into the line	-0.3 Np
The power level of the 84.14 KHz control frequency at the output into the line	-0.9 Np
The maximum gain of the group channel of terminal and attended amplifier stations at the following frequencies, KHz: 36	2.8 Np
84	5.8 Np
92	5.9 Np
143	8.5 Np
The AGC monitor frequencies in the directions:	
B - A	40 KHz (slope type) 80 KHz (flat type)
A - B	92 KHz (flat type); 143 KHz (slope type)
The automatic gain control range at the maximum transmitted frequency in the group of frequencies of: 36 - 84 KHz	5.0 Np
92 - 143 KHz	6.1 Np
The range of the automatic control of the slope of the frequency characteristic in the:	
lower group of frequencies	0 - 3.0 Np
upper group of frequencies	0 - 2.6 Np

The transmit level at the VUS output (for each channel)	+1.4 Np
The maximum gain of a VUS at the following frequencies, KHz:	
36	1.8 Np
84	4.0 Np
92	4.0 Np
143	6.2 Np
The AGC range of the VUS at the maximum transmitted frequency, in the:	
lower group of frequencies	4.3 Np
upper group of frequencies	6.5 Np
The range of the automatic control of the slope of the frequency characteristic of the VUS gain in both transmit directions	2.2 Np

Climatic Operational Conditions:

Terminal and attended amplifier stations at temperatures from 0 to +50° C; ausiliary amplifier stations at temperatures of from -20 to +50° C.

The Electrical Power Supply

Voltages:

Terminal and attended stations: from a DC source at 24 v +15% and -10%; auxiliary amplifier stations: either remotely or from local power supplies at 24 v DC. In the first case, the remote power is realized at a voltage of 250 volts via a "two wires — ground" system with grounding of the negative pole of the remote power supply. In the second case, the power is realized from a voltage source of 24 volts +15%, -10%.

Power Consumption:

Terminal station (without taking into account temporary loads, signaling, ringing, etc.): 80 watts;
Intermediate station: 85 watts;
Remote power supply current: 0.4 amps;
Remote power supply unit (for the maximum length of a repeater section between an OUP and VUS): 100 watts.

Equipment Complement

Terminal Station

There are provision for eight variants. Included in the complement of each terminal station is a rack with the common rack units, support bases and wiring for two terminal stations, as well as a complex of blocks for one terminal station.

The difference in the variants consists in the dependence on the type of station A or B and line spectrum variants I - IV:

Terminal Station A | Terminal Station B

Оконечная станция А	*Оконечная станция Б*
OV-12-3-AI ОВ-12-3-АI	ОВ-12-3-БI OV-12-3-B1
ОВ-12-3-АII	ОВ-12-3-БII
ОВ-12-3-АIII	ОВ-12-3-БIII
ОВ-12-3-АIV	ОВ-12-3-БIV

Not included in the complement of blocks of each terminal station are the remote power supply transmit units.

Included in the equipment complement are eight sets of expander blocks for a terminal station to house a second terminal station in a rack (depending on the operational mode: station A or B and the station spectrum variant I, II, III, IV):

Terminal Station A | Terminal Station B

Оконечная станция А	*Оконечная станция Б*
ОВ-12-3-АI-р OV-12-3-AI-r	ОВ-12-3-БI-р OV-12-3-BI-r
ОВ-12-3-АII-р	ОВ-12-3-БII-р
ОВ-12-3-АIII-р	ОВ-12-3-БIII-р
ОВ-12-3-АIV-р	ОВ-12-3-БIV-р

Not included in the complement of the sets of expander blocks are the remote power transmit units.

The wiring and construction of a rack provide for the capability of housing stations in it which operate in any mode and with any line spectrum variant.

The Intermediate Station

PV-12-3: A rack with the common rack units, support bases and wiring for two intermediate stations, as well as a set of blocks for one intermediate station.

PV-12-3-r: A set of expander blocks for an intermediate station, intended for mounting in a PV-12-3 rack to obtain a second intermediate station.

Not included in the complement of intermediate station blocks and the complement of expander blocks are the remote power supply transmit units.

The Auxiliary Amplifier Station

VUS amplifier equipment: The VUS amplifier equipment can be supplied both with the remote power supplies and with local power supplies. In accordance with this, a provision is made for two equipment variants of the VUS amplifier gear:

The UO-VUS-12-3-1: The amplifier equipment cabinet of the auxiliary amplifier station. Included in the cabinet complex are the PPDP-1 and PPDP-2 blocks for remote power conversion and transmission, which are intended for installation at the terminal or intermediate station which supplies the power.

The UO-VUS-12-3-2: Included in place of the remote power supply conversion and transmission blocks in a voltage supply inverter, which is intended for powering the VUS from a local 24 volt source. The remote power supply transmission units are not included in the VUS complement and are supplied where necessary.

The VUS input equipment: The VO-VUS-12-3 likewise has two equipment complements, which differ in the quality of the blocking filters (ZF) and matching devices installed in them (se Table 3.7.1).

Table 3.7.1.

Equipment	VO-VUS-12-3-I, units	VO-VUS-12-3-II, units
ZF-1 [suppression filter]	1	2
ZF-2	3	5
ZF-3	3	3
ZF-4	1	1
Matching devices	4	8

One input equipment cabinet provides for the entrance of four nonferrous metal circuits, multiplexed up to 150 KHz.

To provide for the capability of standby remote power for the VUS's, the PPDP-1 and PPDP-2 remote power transmit devices are supplied individually. A provision is made for the individual delivery of the SU140 (or 180)/550 matching devices.

Construction

The terminal and intermediate stations of the equipment are housed in the cabinets of the base structure with dimensions of 2,600 x 600 x 225 mm, while the auxiliary amplifier stations are housed in cabinets with dimensions of 1,300 x 650 x 250 mm.

Weight:

Cabinet, with a complete set of two terminal or two intermediate stations	250 kg
The VUS amplifier equipment cabinet	120 kg

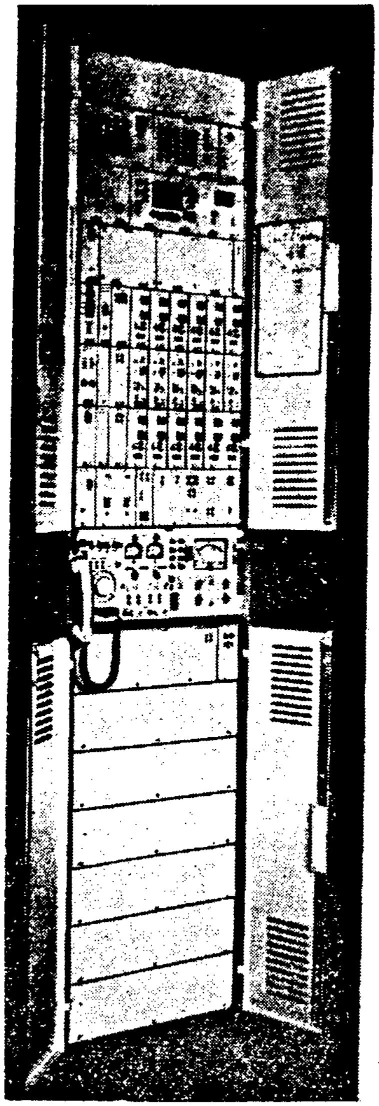


Figure 3.7.1. External view of the V-12-3 terminal station equipment.

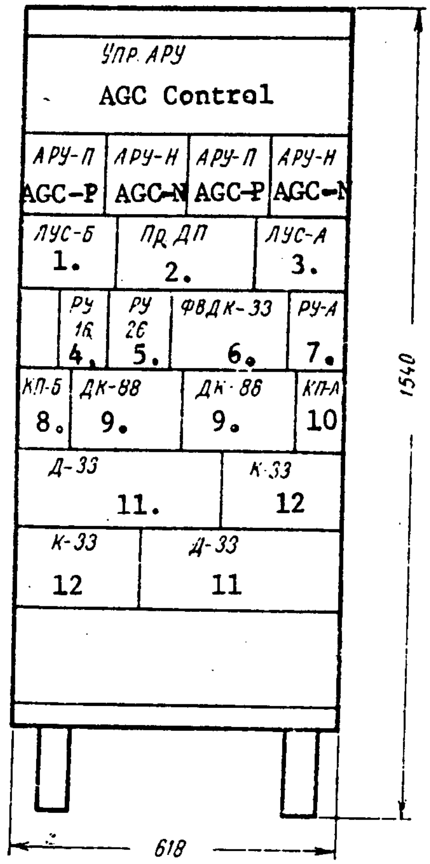


Figure 3.7.2. Placement of the equipment in the VUS-12-3 equipment cabinet.

Key: 1. Line amplifier B;
2. Remote power receive;
3. Line amplifier A;
4. RU 16 [?16 KHz level control?];
5. RU 26;
6. FVDK-33 [?DK-33 filter-equalizer?];
7. RU-A [?"A" level control?];
8. KP-B [expansion unknown];
9. DK-88 filter;
10. KP-A;
11. D-33 Filter;
12. K-33 filter;
AGC-P = Flat type automatic gain control
AGC-N = Slope type AGC.

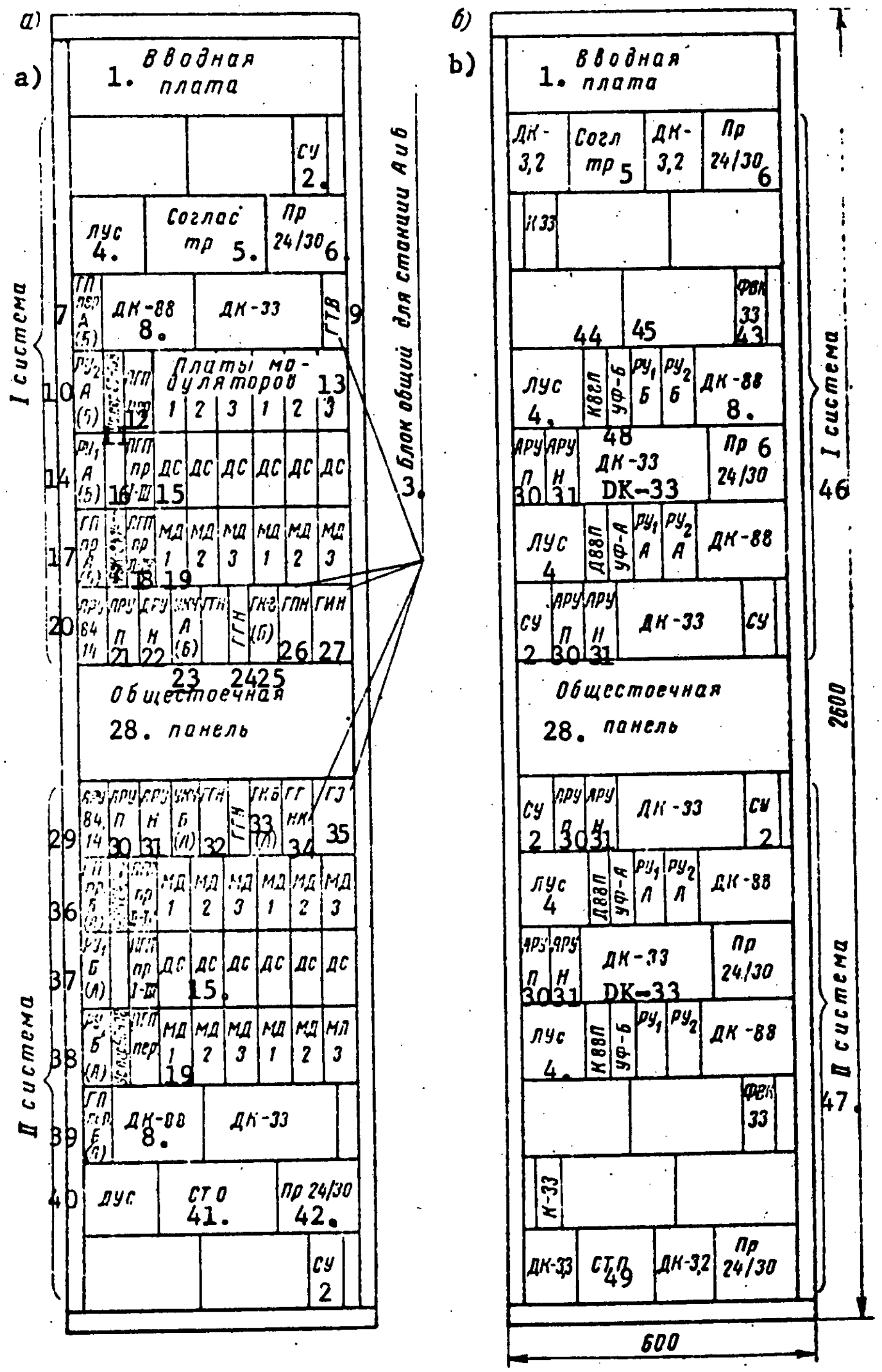


Figure 3.7.3. The placement of the blocks in the V-12-3 equipment racks:
a) Terminal station; b) Intermediate station.

Key: 1. Input panel
2. Matching unit;

[Key to Figure 3.7.3, continued]:

3. Common blocks for stations A and B;
4. Line amplifier;
5. Matching transformer;
6. Pr 24/30 [?24/30 KHz receiver?];
7. GP per A (B) ["A" (or "B") transmit group converter];
8. DK-88 filter;
9. Voice frequency ring generator;
10. RU_2 A (B) ["A" (or "B") level control 2];
11. 60 - 108 KHz transmit amplifier;
12. PGP [expansion unknown] transmit unit;
13. Panels of modulators;
14. RU_1 A (B);
15. Differential systems;
16. PGP receiver, I - III;
17. GP Pr. A (B) [?"A" (or "B") group conversion receiver?];
18. PGP receiver II - IV;
19. MD1 [modulator-demodulator 1];
20. PRU 84 14 [expansion unknown];
21. LRU P [?flat type line level control?];
22. DRU N [unknown type of slope gain control];
23. UKCh A (B) ["A" (or "B") control frequency amplifier];
24. GGN [unknown type of harmonic generator];
25. GK-8 (B) [expansion unknown];
26. GPN [expansion unknown];
27. GIN [expansion unknown];
28. Common rack panel;
29. ARU 84, 14 [84, 14 KHz AGC];
30. ARU P [flat type AGC];
31. ARU N [slope type AGC];
32. GGN [unknown type of harmonic generator];
33. GK-B (A) [expansion unknown];
34. GG NK [unknown type of harmonic generator];
35. GZ [expansion unknown];
36. GP Pr. B (A) ["B" (or "A") receive group converter?];
37. RU_1 B (A) ["B" (or "A") level control 1];
38. RU_2 B (A);
39. GP per. B (A) ["B" (or "A") transmit group converter?];
40. ?LUS? [?line amplifier?];
41. STO [expansion unknown];
42. Pr 24/30 [?24/30 KHz receiver?];
43. FVK 33 [?K-33 filter-equalizer?];
44. K88P filter;
45. RU_1 B ["B" level control 1];
46. System 1;
47. System 2;
48. UF-B ["B" narrow band filter];
49. STP [?intermediate high frequency channel service unit?].

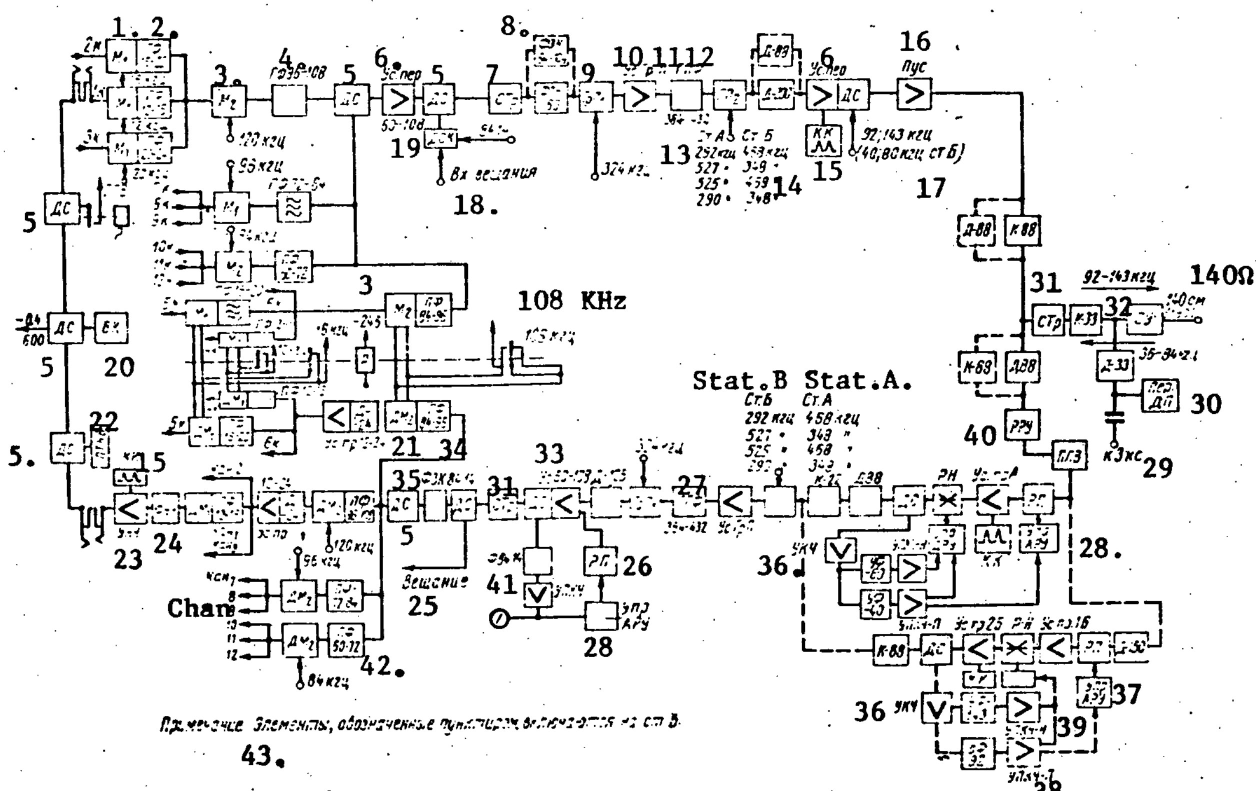


Рис. III.7.4. Блок-схема оконечной станции аппаратуры В-12-3

Figure 3.7.4. Block diagram of the terminal station of the V-12-3 equipment.

Key:
1. M_1 [modulator 1];
2. PF [bandpass filter];
3. Modulator 2;
4. 96 - 108 KHz bandpass filter;
5. Differential system;
6. Transmit amplifier;
7. Matching transformer;
8. FZK 64-104 [unknown type of 64 - 104 KHz filter];
9. Gr P_1 [?group converter 1?];
10. UsGr [group amplifier];
11. L [line];
12. GPF [group bandpass filter];
13. Station A;
14. Station B;
15. KK [correcting network];
16. Pus [unknown type of amplifier];

[Key to Figure 3.7.4, continued];

17. 92, 143 KHz (or 40, 80 KHz, station B);
18. Broadcast input;
19. DSK [expansion unknown];
20. BK [balancing network];
21. DM_2 [demodulator 2];
22. PTNV [voice frequency dial-ring receiver];
23. UNCh [low frequency amplifier];
24. FNCh [low pass filter];
25. Broadcast;
26. RP [flat type gain control];
27. GPF [group bandpass filter];
28. AGC control;
29. To 3 channel systems;
30. Remote power transmit unit;
31. Matching transformer;
32. SU [matching unit];
33. US 60-108 [60 - 108 KHz amplifier];
34. PF 84-96 [84 - 96 KHz bandpass filter];
35. FZK [unknown type of filter];
36. UKCh [control frequency amplifier];
37. AGC control;
38. UPKCh-P [flat type control frequency receiver amplifier];
39. UPKCh-N [slope type control frequency receiver amplifier];
40. RRU [expansion unknown];
41. UPKCh [control frequency receiver amplifier];
42. Pf 60-72 [60 - 72 KHz bandpass filter];
43. Note: Elements indicated with a dashed line are inserted in station B.

[Key to Figure 3.7.5 (see following page 206)]:

1. FVK-33 [K-33 filter-equalizer];
2. KK [correcting network];
3. RRU [unknown type of level control];
4. PLV [expansion unknown];
5. D-150 filter;
6. RP [flat type control];
7. Receive amplifier 1B;
8. RN [slope type control];
9. Receive amplifier 2B;
10. UPKCh-N [slope type control frequency receiver amplifier];
11. K-88 filter;
12. Line amplifier;
13. SU [matching unit];
14. Remote power transmit unit;
15. To 3-channel systems;
16. Matching transformer;
17. Control frequency, 4.5 Np;
18. UPKCh-P [flat type control frequency receiver amplifier];

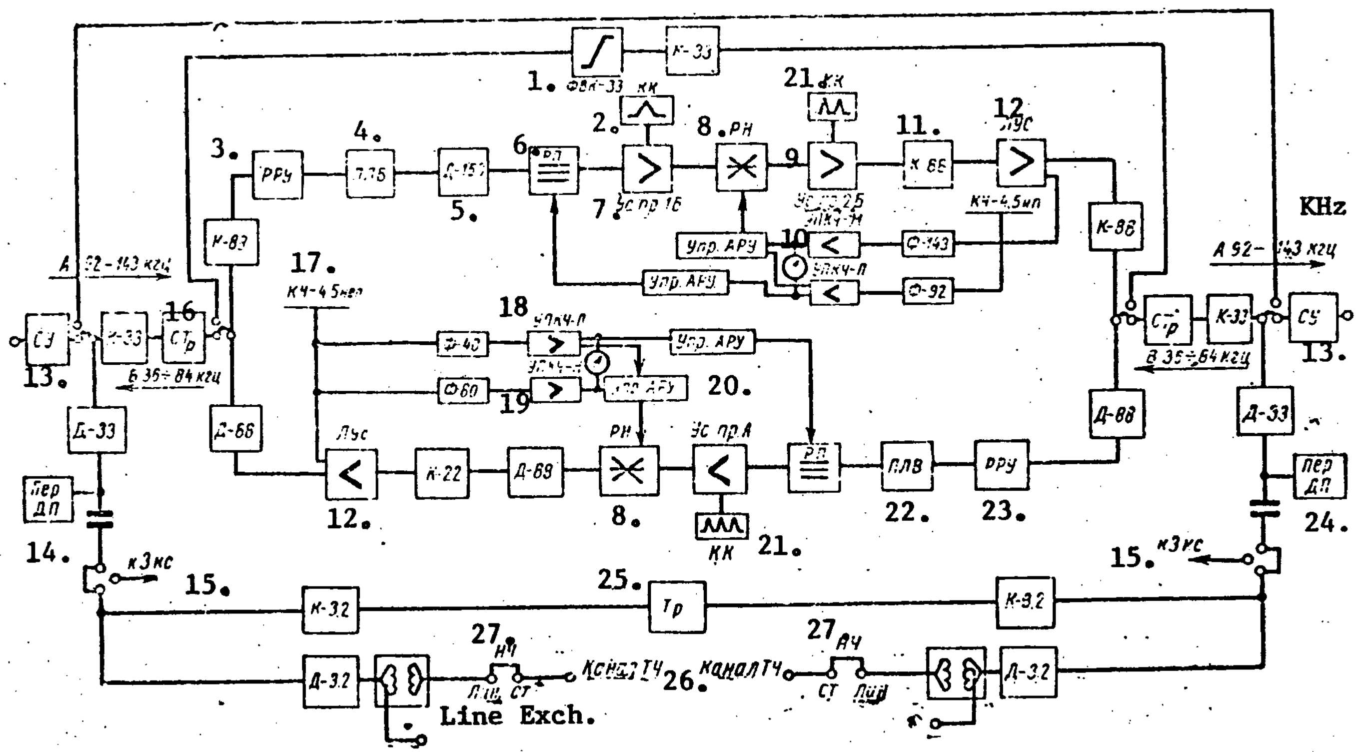


Рис. III.7.5. Блок-схема промежуточной станции аппаратуры В-12-3

Figure 3.7.5. Block diagram of the intermediate station of the V-12-3 equipment.

Key: 19. UPKCh-N [slope type control frequency receiver amplifier];
20. Upr. ARU [AGC control];
21. KK [correcting network];
22. PLV [either a variable or a fixed (acronym ambiguous) line equalizer];
23. RRU [unknown type of level control];
24. Remote power transmit unit;
25. Transformer;
26. Voice frequency channel;
27. Low frequency.

3.8. The BO-12, BO-12-2 Twelve-Channel Transmission System (Manufactured in the Hungarian People's Republic)

Figures 3.8.1 - 3.8.3.

Purpose: Intended for multiplexing open-wire communications lines. The BO-12-2 is a modernized BO-12. The electrical characteristics of the BO-12-2 and BO-12 are close to that of the V-12-2 and V-12-3 domestic equipment.

Type of Line Used: Open-wire copper or bimetal circuit with 3 - 4 mm diameter conductors.

Communications System: Two-band, electrically four-wire, physically two-wire.

Electrical Characteristics:

The line frequency spectrum: BO-2 Spectra A, B, C, D, E, F
BO-12-2 Spectra A, B, C, D.

Line Spectrum Варианты линейного спектра Variants	Line Spectrum Линейный спектр кгц KHz	Контрольные частоты, кгц, для аппаратуры 1.	
		БО-12 BO-12	БО-12-2 BO-12-2
A - B Direction	Направление А—Б		
A	92÷140 (о) (o)		
B	95÷143 (п) (p)	92 и 143	92 и 143
C	93÷141 (п)		
D	94÷142 (о)		
E	92÷140 (п)	96 и 136	
F	92÷140 (о)		
A - B Direction	Направление Б—А		
A	36÷84 (п)		
B	36÷84 (о)		40 и 80
C	36÷84 (п)	40 и 80	
D	36÷84 (о)		
E	36÷84 (о)		
F	36÷84 (п)		

Key: 1. Control frequencies, KHz, for the following equipment:;
Note: The standard position of the channels is indicated by a п [p], and the inverse by o.

The number of channels which can be organized 12

The effectively transmitted bandwidth of the channels 300 - 3,400 Hz

Note: Frequency conversion in the BO-12-2 equipment (just as in the BO-3-2 system) is based on pre-group modulation. The 300 - 3,400 Hz voice frequency spectrum is converted in the transmission spectrum by individual frequencies of 12, 16 and 20 KHz, with the formation of a pre-group in the 12 - 24 KHz spectrum. Subsequently, the pre-groups are converted to the main group at 60 - 108 KHz using frequencies of 84, 96, 108 and 120 KHz.

The main group is converted to the 408 - 456 KHz spectrum in the third conversion stage by means of the 348 KHz carrier frequency, and subsequently by 316, 551, 549 and 314 KHz carriers, as well as 492 and 372 KHz frequencies, the line frequency spectra adopted in the system are derived.

Maximum communications range	10,000 km, with 5 retransmission sections	
The same, without repeater stations	80 - 150 km	
The nominal relative transmit level at the output of the terminal and intermediate stations	+2.0 Np	
The normal receive level at the input at 143 KHz	-2.0 Np	
The minimum receive level at the input at 143 KHz	-6.5 Np	
The nominal relative voice frequency levels of the channels:	BO-12, Np	BO-12-2, Np
Transmission in the four-wire section of a channel	-2.0 - 1.0	-1.5
Reception in the four-wire section of a channel	-0.5 - +1.0	+0.5
Reception and transmission in the two-wire section of a channel	-0.4/-0.8	-0.4/-0.4 or 0/-0.8
Attenuation of nonlinear distortion of the amplifiers at an output level of +2.0 Np with respect to the:		
Second harmonic	8.1	8.5
Third harmonic	9.2	9.6

The input impedance of the equipment from the:	
Station and line end	600 ohms
Group end	150 (or 135) ohms

Note: In the BO-12-2 equipment, a matching transformer matches the input impedances of the equipment (600 ohms) to the line cable input (120 or 200 ohms).

The AGC system	Electromechanical, dual frequency (flat and sloped)
Voice frequency ringing frequency:	
BO-12	3,825 Hz
BO-12-2	2,100 Hz

Note: Direct current ringing is also provided going to the switchboard when working via a four-wire circuit, as well as 17 - 50 Hz ringing when working via a two-wire circuit.

Climatic Operational Conditions: At temperatures of from +10 to +40°, and a relative ambient air humidity of 80% at +20° C.

The Electrical Power Supply:

Voltages:

BO-12. Alternating current at 110, 127 or 220 volts ± 3% at 50 - 60 Hz. There is an AC power supply block in the equipment, which provides the following voltages at the output: 206 volts (for the plate circuit), 20 volts (AC voltage for the filament circuit), and 24 volts (DC voltage for powering relay circuits). Provision is made for powering the equipment from DC sources:

Plate	206 volts ± 3%
Filament	21.2 volts ± 3%
Signaling	24 volts ± 10%
Power consumed by the power supply from the AC mains	500 VA

BO-12-2. The terminal and intermediate stations are powered from the AC mains or from DC sources (storage batteries).

Current Consumption

Station	206 v + 3% amps	21.2 v + 3% amps	24 v + 10% amps	250 v for remote pwr amps	220 v +3% amps
Terminal	0.25	2.7	2.0	0.3	1.2
Intermediate	0.5	3.7	1.3	0.3	1.3

The terminal and intermediate stations provide power and the interconnection capability for the domestic VUS-12-2 equipment. Installed for this at the terminal station is one, and at the intermediate station, two sets of devices for remote power transmission.

The equipment is supplied with a power supply using DC sources and the VUS-12-2 power supply units, and with power from the AC mains without the VUS-12-2 remote power supply devices.

Equipment Complement:

BO-12. Terminal station: Two SIO and SGO racks. Intermediate station: One rack.

BO-12-2: The terminal or intermediate station is housed in one cabinet, where there are the following: generator equipment, blocks of channels, jackfield, power supply block, input terminal blocks (SIO-12 racks are not required for the BO-12-2 station). A generator for fixed frequencies in the 300 - 3,400 Hz range and a level meter are built into the equipment for performing tests and measurements.

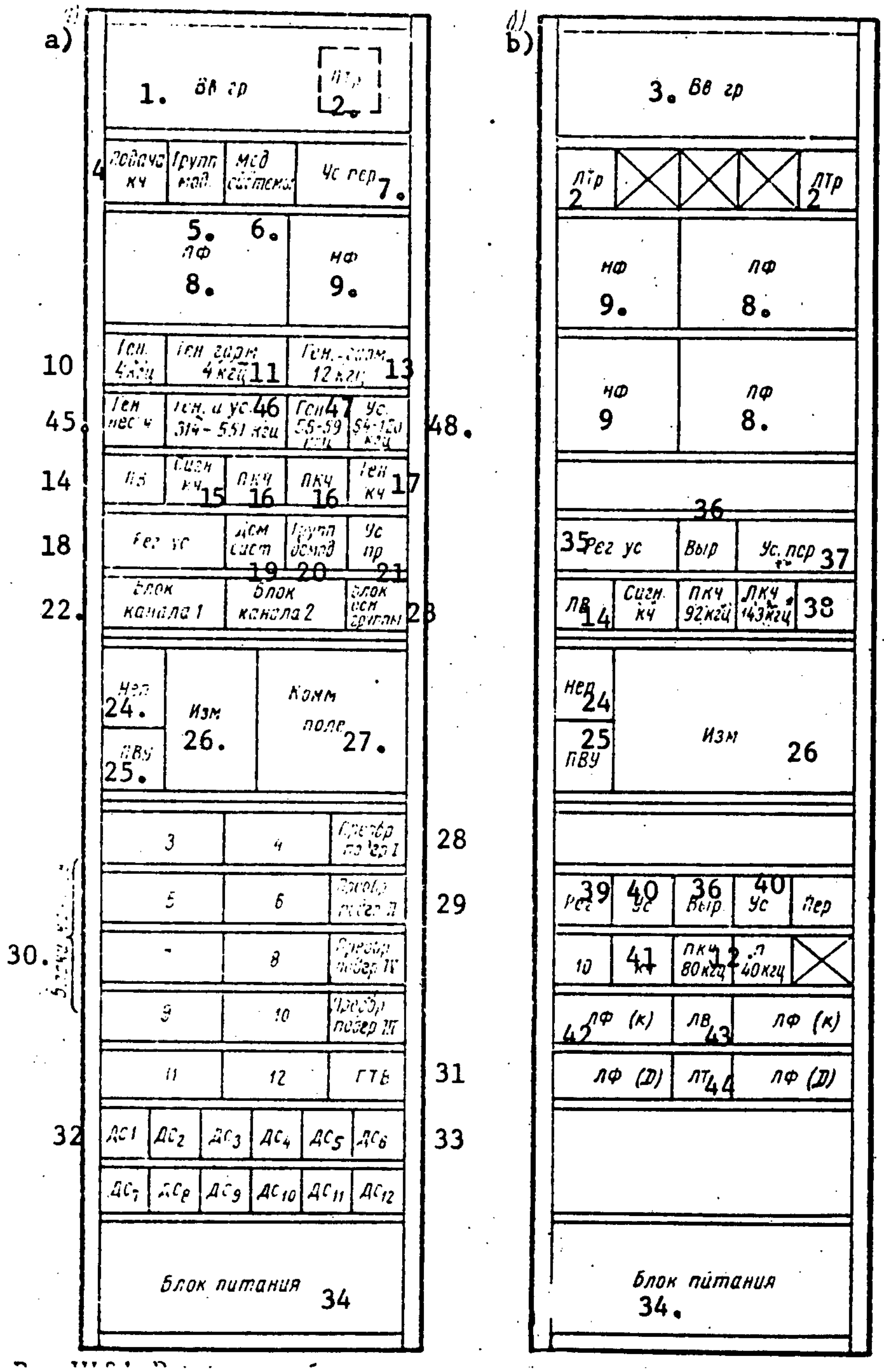


Figure 3.8.1. The placement of the equipment in the rack of the terminal (a) and intermediate (b) stations of the BO-12-2 equipment.

Key: 1. Input terminal blocks;
2. Line transformer;
3. Input terminal blocks;
4. Control frequency feed;
5. Group modulator;
6. System modulator;
7. Transmit amplifier;
8. PF [bandpass filter];

Construction:

BO-12. The terminal station. The dimensions of each rack are 2,600 x 680 x x 250 mm. The intermediate station. The rack dimensions are 1,765 x x 680 x 250 mm.

Note: It is permissible to install the racks with their backs facing each other.

BO-12-2. The overall cabinet dimensions are 2,600 x 66 x 280 mm. All of the equipment blocks are removable. The front of the cabinet is enclosed with doors.

Weight: 350 kg (one rack or cabinet).

[Key to Figure 3.8.1, continued]:

9. NF [routing filter];
10. 4 KHz generator;
11. 4 KHz harmonic generator;
12. 80 KHz control frequency receiver;
13. 12 KHz harmonic generator;
14. LV [?line equalizer?];
15. Control frequency signaling;
16. Control frequency receiver;
17. Control frequency generator;
18. [?gain control?];
19. System demodulator;
20. Group demodulator;
21. Receive amplifier;
22. Channel 1 block;
23. Main group block;
24. [?neper meter?];
25. Intercom-callup unit;
26. Meter;
27. Jackfield;
28. Subgroup I converter;
29. Subgroup II converter;
30. Blocks of channels;
31. GTV [voice frequency ringing generator];
32. Differential system 1;
33. Differential system 6;
34. Power supply block;
35. [?gain control?];
36. Equalizer;
37. Transmit amplifier;
38. 143 KHz control channel receiver;
39. Adjuster;
40. Amplifier;
41. Control frequency;
42. LF (K) [(K type) line filter];
43. LV [?line equalizer?];
44. LT [?line transformer?];
45. Carrier frequency generator;
46. 314 - 551 KHz generator and amplifier;
47. 56 - 59 KHz generator;
48. 84 - 120 KHz amplifier.

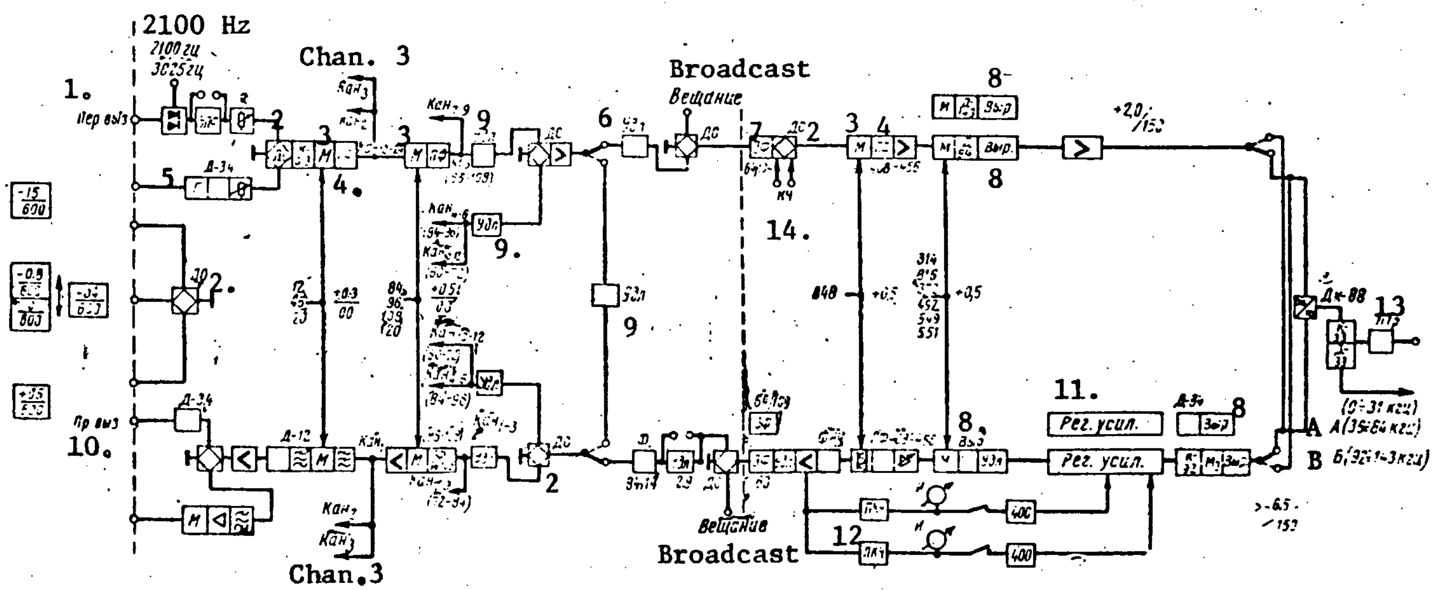


Рис. III.8.2. Блок-схема оконечной станции аппаратуры БО-12-2

Figure 3.8.2. Block diagram of the terminal station of the BO-12-2 equipment.

Key: 1. Ring transmit;
2. DS [differential system];
3. M [modulator];
4. PF [bandpass filter];
5. G [generator];
6. Pad;
7. ZF [suppression filter];
8. Equalizer;
9. Pad;
10. Ring receive;
11. Gain control;
12. Control channel receiver;
13. Line transformer

ФНЧ = low pass filter
И = meter

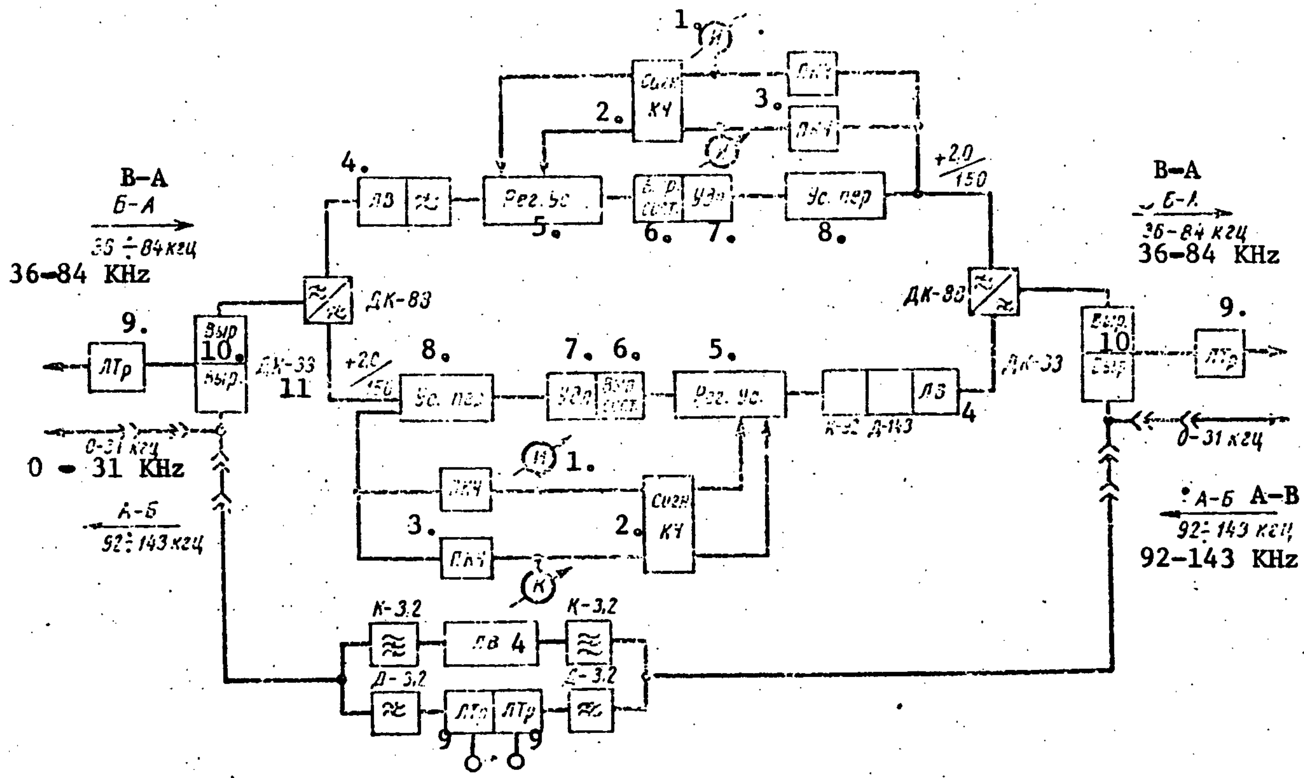


Figure 3.8.3. Block diagram of the attended repeater station of the BO-12-2 equipment.

Key:
1. Meter;
2. Control frequency signaling;
3. Control frequency receiver;
4. LV [line equalizer];
5. Gain control;
6. System equalizer;
7. Pad;
8. Transmit amplifier;
9. Line transformer;
10. Equalizer.

SECTION 4. Transmission Systems Using Balanced Communications Cables

4.1. The K-3 Three-Channel Transmission System (taken out of production). Figures 4.1.1 - 4.1.4.

Purpose: Intended for multiplexing cable lines or steel open wire circuits for intra-oblast' and rural service.

Type of Line: PRPPM cable with 1.2 mm diameter cores (or of a smaller diameter, but with correspondingly smaller line sections). Steel circuits in the absence of HF telephony on parallel circuits.

Communications System: Single cable, two-band, electrically four-wire, physically two-wire.

Electrical Characteristics:

Line frequency spectrum:

Линейный спектр частот:

	Channel 1, KHz Канал 1, *кгц*	Channels 2/3 KHz Каналы 2/3, *кгц*
Direction A-B Направление *А-Б*	3,7÷6,1	8,3÷15,7
Б-А B-A	0,3÷2,7	18,9÷26,8

The effectively transmitted passband of the channels:

1	0.3 - 2.7 KHz
2/3	0.3 - 3.4 KHz

The number of channels which can be organized 3

The maximum communications range:
Via cable lines with two repeater stations 50 km
Via open wire, steel circuits (without repeater sections):

1. Диаметр проводов, *мм*	2. Расстояние между проводами, *см*	3. Дальность связи, *км*
3	20	20
3	40	25
3	60	26
4	20	27
4	40	30
4	60	32

Key: 1. Diameter of the conductors, mm
2. Spacing between the conductors, cm;
3. Communications range, km.

The length of a repeater section using cable circuits:

Maximum	16.5 km
Minimum	8 km

The input impedance from the:	Station end	600 ohms
	Line end	90 ohms; 180 ohms; 800 ohms; 1,400 ohms (depending on the type of line)
The residual channel attenuation at 800 Hz when a 0.4 Np pad for two-wire through working is inserted		0.8 Np
The channel stability with a residual attenuation of 0.8 Np		no less than 0.6 Np for the case of no load from the switchboard end
The nominal relative transmit level of one channel at the station output		-0.4 Np for a load of 600 ohms
The amplitude characteristic of the channel		Flat within 0.1 Np when the level increases by 0.5 Np with respect to the measurement level
The nonlinear distortion factor when 400 Hz is fed into the channel at the nominal measurement level		No more than 5%
The perceptible crosstalk isolation between channels		No less than 6.7 Np
The internal noise voltage at the point with a relative level of -0.8 Np when working with two NUP's [unattended repeater stations];		2.0 mv psophometric
Voice frequency ringing at the following frequencies for the following channels:		
	1	3.0 KHz
	2 and 3	3.8 KHz

Note: A provision is made for the reception and transmission of semiautomatic and automatic dial signals via each of the channels.

The climatic operational conditions: At a temperature of from +15 to +40° C, and a relative ambient air humidity of 85%.

The Electrical Power Supply:

Voltages:	Terminal station	24 volts ± 10%
	Remote power for the intermediate stations	60 volts ± 10% using a "wire-wire" system
	Signaling	24 volts or 60 volts (separate batteries)
Current Consumption:	Terminal station (for three channels	0.12 amps (without considering the current consumption for the ringing devices), 0.48 amps (when the ringing devices operate)
	Intermediate station	0.045 amps.

Equipment Complement

Terminal Station. The OK-1A or OK-1B single channel set for the first channel; The OK-2A or OK-2B two-channel set for the second and third channels; the VO auxiliary equipment for transmitting the remote power, and receiving the ring voltage (has a signaling device for blown fuses); a protection panel and a line transformer, LTr (mounted outside the equipment).

Intermediate Station. The PK intermediate set for lines longer than 16.5 km.

Construction:

The OK-1A, OK-1B, OK-2A and OK-2B terminal stations, as well as the auxiliary equipment, are mounted on separate panels, which can be desk mounted or mounted in standard line equipment shop bays.

The blocks are arranged on one side on the panels. The blocks are tied into the circuitry by means of five-contact plugs.

Dimensions: OK-1A (or OK-1B) - 147 x 450 x 325 mm; OK-2A (or OK-2B) - 240 x x 450 x 325 mm; VO - 147 x 450 x 275 mm.

Note: The equipment is designed around type P206, P14, P4V, P13B and D2V transistors.

Weight: Each terminal station weighs roughly 60 kg.

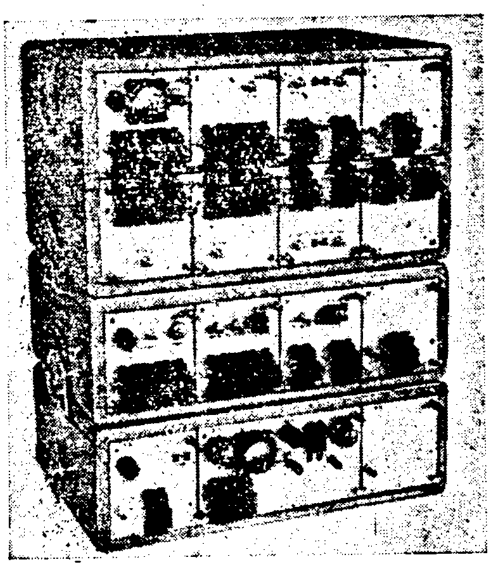


Figure 4.1.1. Exterior view of the K-3 equipment.

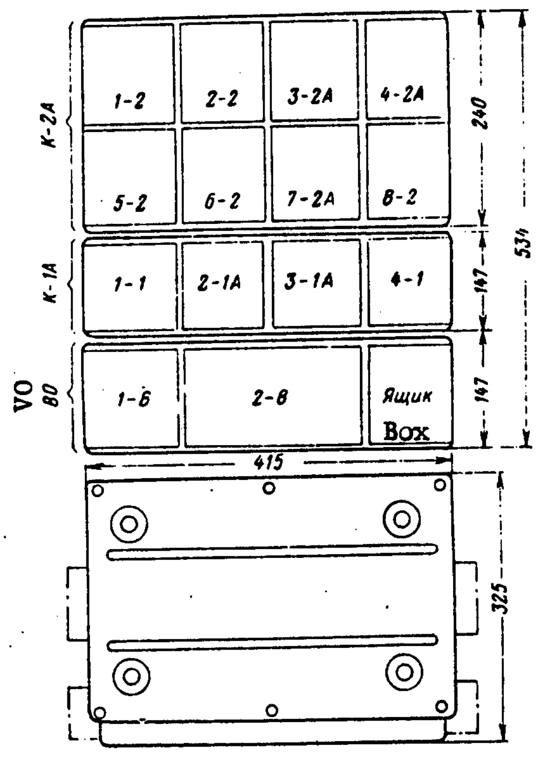


Figure 4.1.2. The order for joining the racks of the K-3 equipment together. Key: VO = Auxiliary equipment

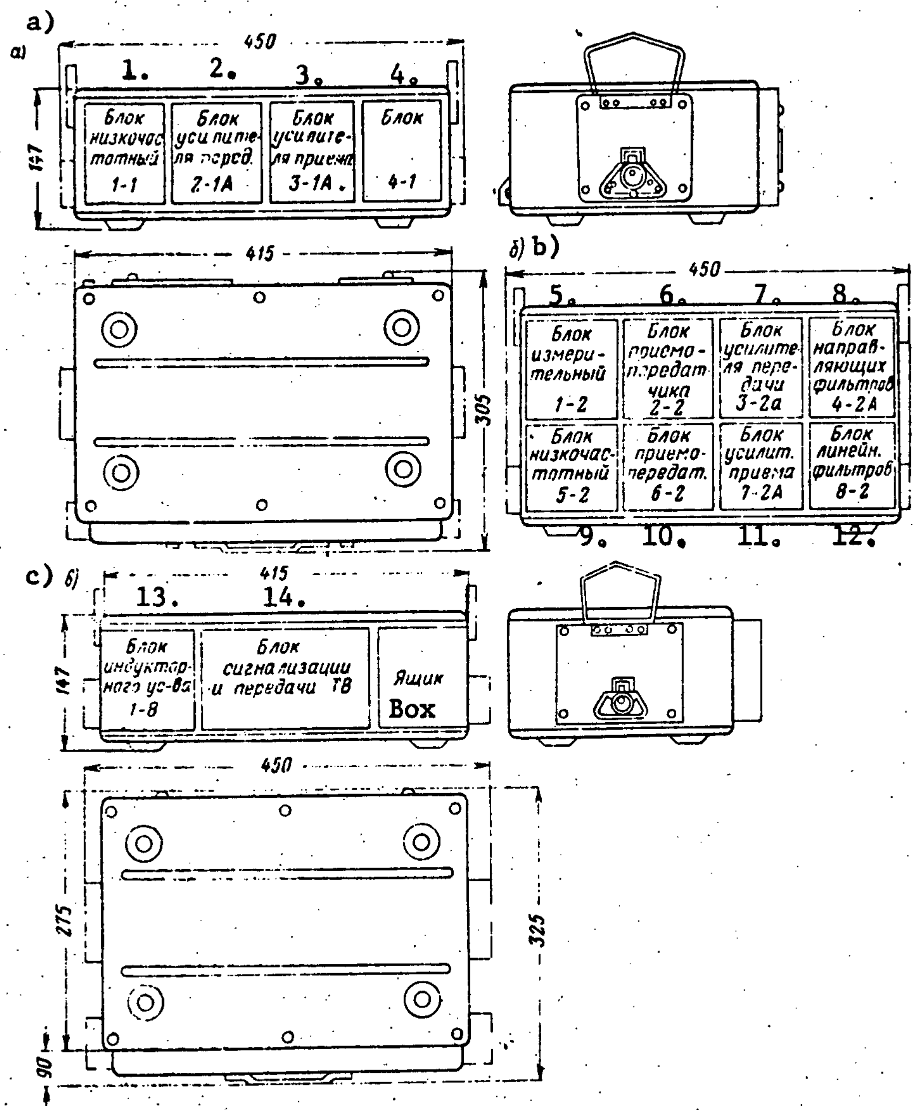


Figure 4.1.3. The placement of the equipment in the K-3 terminal station:
a) Terminal station for the first channel, OK-1;
b) Terminal station for the second and third channels, OK-2;
c) Auxiliary equipment, VO.

Key:
1. Low frequency block, 1-1;
2. Transmit amplifier block, 2-1A;
3. Receive amplifier block, 3-1A;
4. Block 4-1;
5. Measurement block, 1-2;
6. Transceiver block, 2-2;
7. Transmit amplifier block, 3-2a;
8. Block of routing filters, 4-2A;
9. Low frequency block, 5-2;
10. Transceiver block, 6-2;
11. Receive amplifier block, 7-2A;
12. Block of line filters, 8-2;
13. Magneto ringer block, 1-8;
14. Signaling and voice frequency ring transmit block.

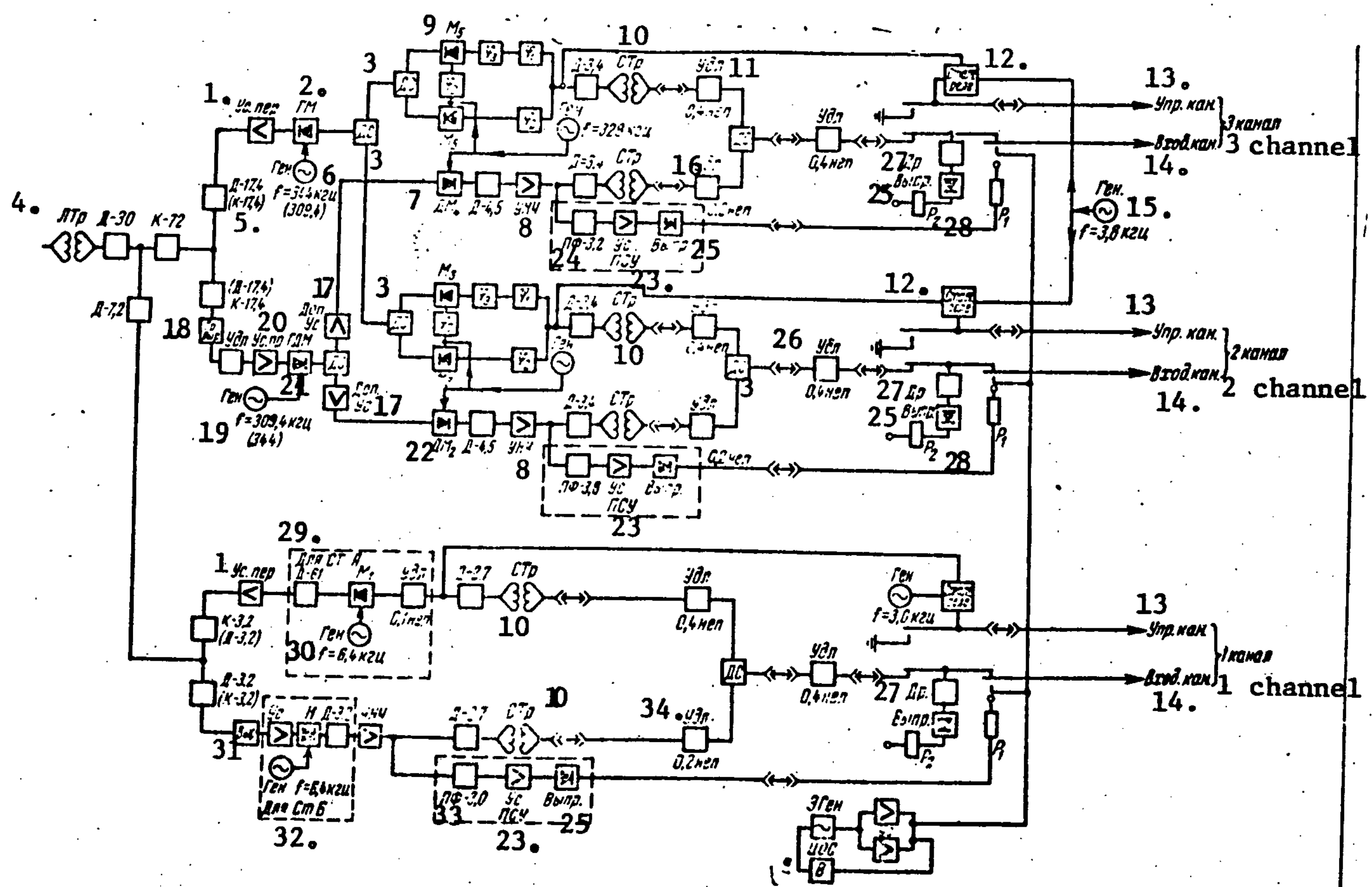


Figure 4.1.4. Block diagram of terminal station A of the K-3 equipment for one to three channels (for station B, the data are given in parentheses).

Key:
1. Transmit amplifier;
2. GM [group modulator];
3. DS [differential system];
4. Line transformer;
5. D-17.4 (or K-17.4) filter;
6. Oscillator, f = 344 (or 309.4) KHz;
7. DM_4 [?demodulator 4?];
8. Low frequency amplifier;
9. Modulator 5;
10. STr [matching transformer];
11. Pad, 0.4 Nepers;
12. Static relay;

[Key to Figure 4.1.4, continued]:

13. Control channel;
14. Input channel
15. Oscillator, f = 3.8 KHz;
16. Pad, 0.2 Nepers;
17. Supplemental amplifier;
18. Group equalizer;
19. Oscillator, f = 309.4 (or 344) KHz;
20. Receive amplifier;
21. GDM [?group demodulator];
22. Demodulator 2;
23. PSU [unknown type of amplifier panel];
24. PF-3.2 [3.2 KHz bandpass filter];
25. Rectifier;
26. Pad, 0.4 Nepers;
27. Choke;
28. Relay 2;
29. For station A;
30. Oscillator, f = 6.4 KHz;
31. Equalizer;
32. For station B;
33. 3.0 KHz bandpass filter;
34. Pad, 0.2 Nepers.

4.2. The KNK-6t and KNK-6s Six-Channel Transmission System (Manufactured in the Czechoslovakian Socialist Republic)

Figures 4.2.1 - 4.2.6.

Purpose: Intended for the HF multiplexing of non-coil-loaded cables over short distances. The KNK-6t equipment is a modification of the KNK-6s equipment. At the present time, the KNK-6s equipment is not being supplied.

Type of Line: Balanced, non-coil-loaded cables with 0.8 - 1.5 mm diameter copper cores.

Communications System: Single cable, two-band.

Note: When using the KNK-6t or KNK-6s equipment, it is not permissible to multiplex the remaining pairs of a cable with other HF multiplex systems. When multiplexing only part of the pairs of a non-coil-loaded cable with KNK-6t or KNK-6s systems, suppression filters are to be inserted in the remaining pairs of this cable at the intermediate amplifier points.

Electrical Characteristics:

The line frequency spectrum: A-B direction	16 - 60 KHz
B-A direction	76 - 120 KHz
The number of HF channels which can be set up	6
The effectively transmitted passband	300 - 3,400 Hz
The maximum length of a repeater section for VTSP cable	16 km

Note: The KNK-6t equipment channels with companders provide for up to three transits without noticeable degradation of the speech quality.

The maximum number of repeater sections:	
For the KNK-6s	4
For the KNK-6t for multiquad cables	5
The same, for single quad cables	7
The nominal relative levels in the four wire part of the channels, with respect to voice frequencies:	
At the input	-1.5 Np
At the output	+0.5 Np
The capability of secondary multiplexing of HF channels	Permitted in each system is the multiplexing of two channels with voice frequency telegrapy at a power of 135 or 270 μw. A provision is made in the KNK-6t for the option of organizing a broadcast channel via a phantom circuit in a 1,000 - 7,000 Hz spectrum.
The nominal value of the relative transmit level (with respect to power) at the output of terminal and intermediate stations, at the following frequencies:	
120 KHz	-1.5 Np
60 KHz	-2.4 Np
The minimum value of the input level	-7.5 Np
The input impedance of the equipment from the:	
Line end (through a matching transformer)	120 or 150 ohms
Station end	600 ohms
The individual (channel) carrier frequencies, KHz	
Channel 1	120
Channel 2	112
Channel 3	104
Channel 4	96
Channel 5	88
Channel 6	80
The group carrier frequency	136 KHz
The frequency for synchronizing the carrier frequencies (transmitted by station A)	120 KHz
The perceptible crosstalk isolation between the channels of one system, without companders:	
KNK-6t	6.5 Np
KNK-6s	5.5 Np

The gain control range (manual) in the channel block	$\pm$ 0.7 Np
The seasonal gain control range in the receive section of the group block	$\pm$ 0.3 Np
The AGC system (only for KNK-6t intermediate stations on a single quad cable)	Based on the ground temperature
The temperature range of control using ground referenced AGC	From -5 to +18° C
The relative variation in the gain of the intermediate amplifiers with respect to the gain at a temperature of +7° C	Maximum, $\pm$0.1 Np Minimum, $\pm$0.6 Np
Ringup system	With a 3,850 Hz frequency (outside the HF channel).

Climatic Operational Conditions:

Terminal stations at temperatures of from +10 to +40° C, and a relative humidity of 45 - 75%;
Intermediate stations at temperatures of from -5 to +20° C, and a relative humidity of 45 - 75%.

The Electrical Power Supply:

Voltages:

Terminal Stations	Alternating current mains at 220 v $\pm$ 3%. Emergency power from 60 volts (only for the KNK-6t equipment)
Intermediate stations	Remote power from 60 volts.

Current and Power Consumption

Equipment	Power, VA, at 220 volts AC	Current, amps, at 60 volts DC
Terminal station, without regulators for 12 and 24 channels:		
KNK-6s	90	-
KNK-6t	120	4.0
The same, with regulators:		
KNK-6s	260	-
KNK-6t	275	4.0
Intermediate station (remote power):		
KNK-6s	-	0.020
KNK-6t for single quad cable	-	0.015
KNK-6t for multiquad cable	-	0.020

Equipment Complement

KNK-6c:

Terminal Station. It is manufactured in four variants, depending on the spectrum of frequencies transmitted into the line and the number of systems installed in a bay: ST4A; ST4B; ST2A; and ST2B. The index A indicates that the rack transmits 16 - 60 KHz into the line, and the index B indicates 76 - 120 KHz. The indices 2 and 4 indicate the maximum number of systems which can be mounted in a rack.

Each rack contains the following: cabinet, panel of input terminal blocks, a filter for the synchronization frequency at stations A or B (depending on the spectrum of transmitted frequencies), a block for A or B service communications, control panel, A or B carrier frequency generator, power supply panel remote power transmit panel, service communications handset, and set of spare parts.

The following equipment is supplied on special order: KS-6 six-channel groups, the number of which corresponds to the number of systems installed in a rack; group system block with the designation of the type of cable; the number of blocks corresponds to the number of systems; remote power supply unit; AC voltage regulator; connecting boxes for the entrance of line cables, which contain cable terminal strips, dischargers and voice frequency transformers for the creation of phantom circuits.

The ST4A and ST4B stations can be put together in sets of 1 - 4 systems, and the ST2A and ST2B stations, 1 - 2 systems.

Intermediate Station. Included in the station complement are: four amplifiers (two of them standby), two connecting boxes, which contain cable terminal strips and discharges. The connecting boxes are supplied with sections of single quad cable 2.5 m long.

KNK-6t:

Terminal Station. It is manufactured and fitted out just as the KNK-6s terminal station, i.e. the ST4A, ST4B, ST2A, and ST2B stations.

Each rack contains the following: cabinet, panel of input terminal blocks, control panel, A or B carrier frequency generator, block of signal generators, power supply block, A or B service communications block, service communications handset, a set of accessories and a small set of spare parts. Besides this, the station is outfitted with the following equipment: a connection box, measurement generator, transistorized level meter, psophometric voltmeter, AC voltage regulator, and a power supply working from 60 volts.

Notes: 1. On special order, six-channel sets (SKS6 [Latin letters]) can be supplied, and in this case, it is necessary to indicate the requisite type of differential systems (for manual or automatic operation).

2. It is necessary to keep in mind that the individual parts of the KNK-6t and KNK-6s equipment are not mutually interchangeable.

3. For lines with one, two and three intermediate stations, it is necessary to order one remote power transmit block, and for lines with a large number of intermediate stations, two remote power blocks.

4. The 220 volt voltage regulator (can supply one terminal station rack).

Intermediate Station. The intermediate station with AGC is intended for hookup to a single quad cable, and consists of the following: cast iron box, brass box with two operational and one standby amplifier, two connecting boxes with cable sections, set of hookup accessories and a small set of spare parts.

The intermediate station without AGC for multiquad cable has the following complement: cast iron box, brass box for housing 10 amplifiers, two connecting boxes with cable sections, sets of spare parts for hookup and a small set of spare parts.

Notes: 1. Blocks of amplifiers (for multiquad cable) and supplemental connecting boxes for the connection of broadcast equipment via a phantom circuit can be supplied on special order.

2. When ordering intermediate stations, the type of cable for which this station is intended should be indicated.

Construction:

The terminal stations are made in the form of cabinets with the following dimensions: The ST4A and ST4B stations: 2,600 x 626 x 225 mm; the ST2A and ST2B stations: 2,120 x 625 x 225 mm. The intermediate stations for a single quad cable for the KNK-6s and KNK-6t equipment are made in a structurally similar manner with dimensions of 540 x 1,160 x 254 mm, and are intended for being buried in the ground.

The intermediate station for multiquad cable is intended for installation in an unheated room (or in a manhole) and has dimensions of 1,025 x 760 x 280 mm

Weight:

ST4A and ST4B terminal stations	275 kg
ST2A and ST2B terminal stations	185 kg
Unattended repeater station for 1 x 4 cable	105 kg
Connecting box	50 kg

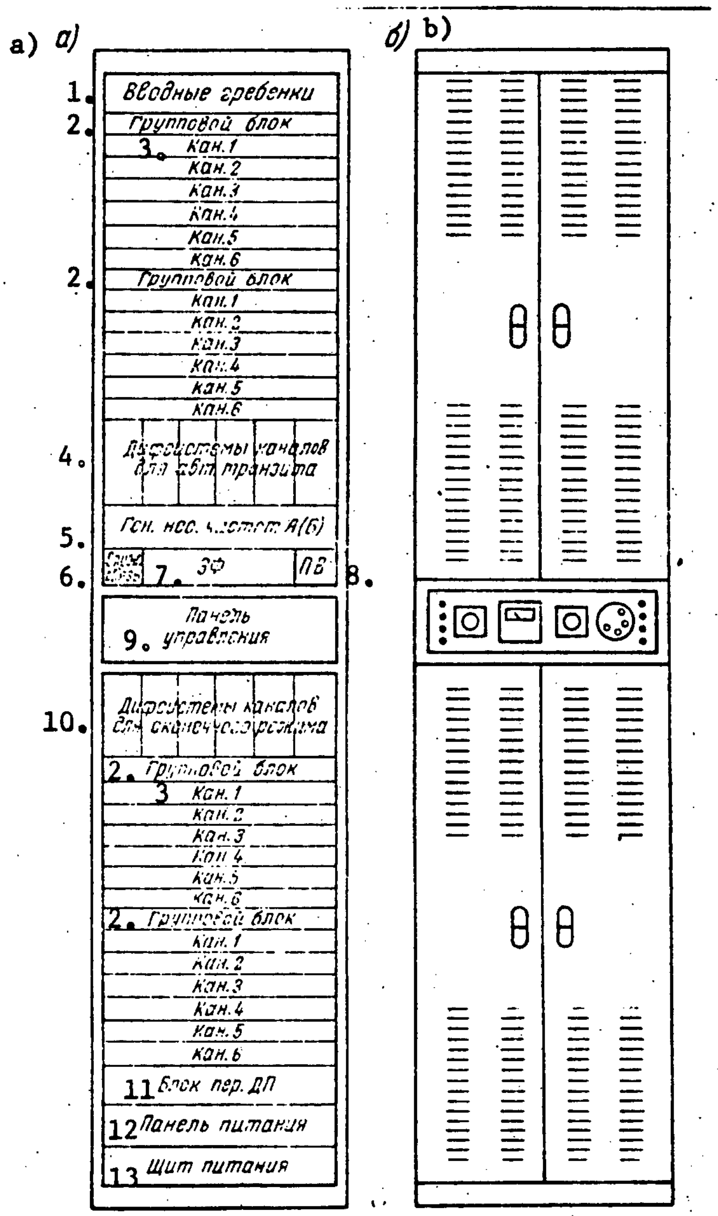


Figure 4.2.1. The placement of the equipment in the terminal station of the KNK-6t equipment for four systems:
a) without the doors; b) with the doors.

Key:
1. Input terminal blocks;
2. Group block;
3. Channel 1;
4. Differential systems of channels for automatic through working;
5. A (or B) carrier frequency generator;
6. Service communications;
7. ZF [suppression filters];
8. PV [?ring receiver?];
9. Control panel;

[Key to Figure 4.2.1, continued]:

10. Differential systems of the channels for the terminal mode;
11. Remote power transmit block;
12. Power supply panel;
13. Power supply board.

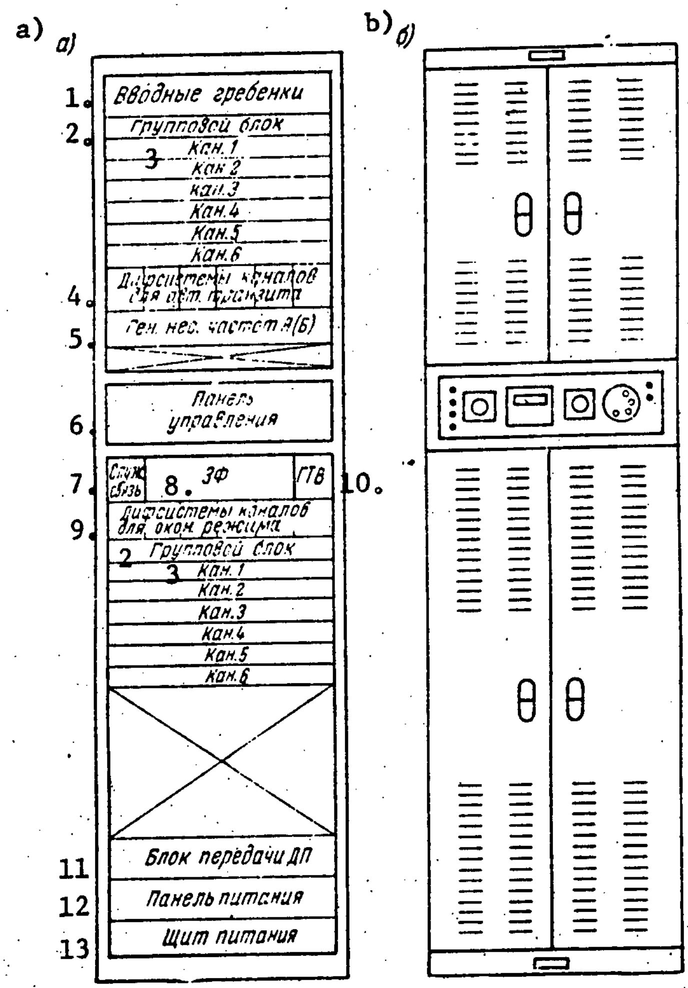


Figure 4.2.2. The placement of the equipment in the terminal station of KNK-6t equipment for two systems:
a) Without the doors; b) With the doors.

Key: 1. Input terminal blocks;
2. Group block;
3. Channel 1;
4. Differential systems of the channels for automatic through-working;
5. A (or B) carrier frequency generator;
6. Control panel;
7. Service communications;
8. Suppression filters;
9. Differential systems of the channels for the terminal mode;

[Key to Figure 4.2.2, continued]:

10. GTV [voice frequency ringing generator];
11. Remote power transmit block;
12. Power supply panel;
13. Power supply board.

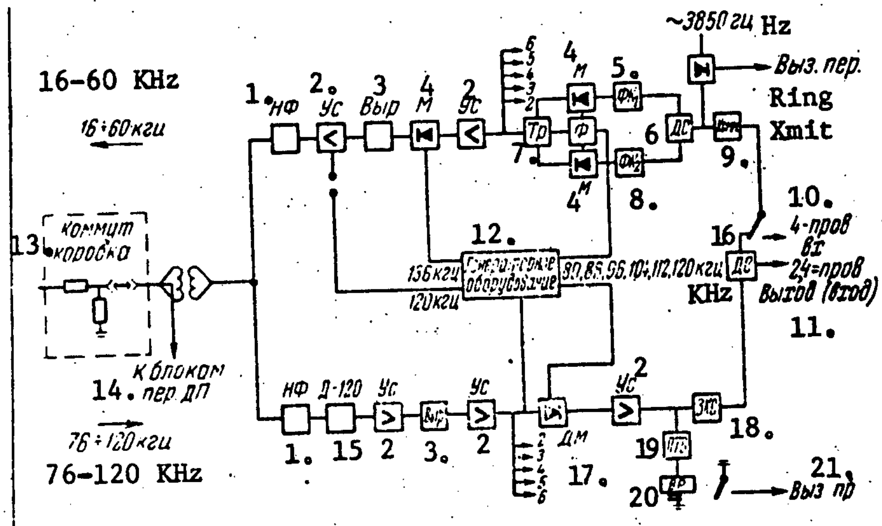


Рис. IV.2.3. Блок-схема оконечной станции А аппаратуры КНК-6т

Figure 4.2.3. Block diagram of terminal station of the KNK-6t equipment.

Key:
1. NF [routing filter];
2. Amplifier;
3. Equalizer;
4. Modulator;
5. FK_1 [channel 1 filter?];
6. Differential system;
7. Transformer;
8. FK_2;
9. Komp [compander];
10. Four-wire input;
11. 2, 4-wire output (or input);
12. Generator equipment;
13. Connection box;
14. To the remote power transmit blocks;
15. D-120 filter;
16. Differential system;
17. Demodulator;
18. ZKS [expansion unknown];
19. PTV [voice frequency ring receiver];
20. VR [?ring relay?];
21. Ring receive.

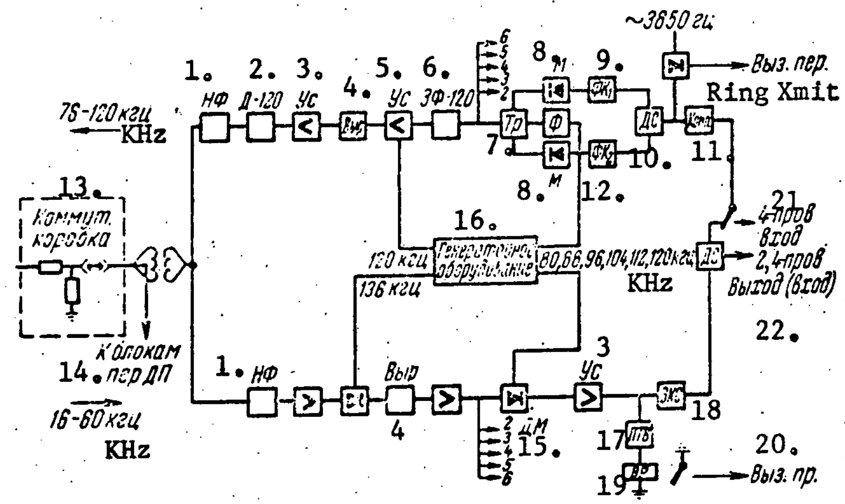


Figure 4.2.4. Block diagram of terminal station B of the KNK-6t equipment.

Key: 1. NF [routing filter];
2. D-120 filter;
3. Amplifier;
4. Equalizer;
5. Amplifier;
6. ZF-120 [120 KHz suppression filter];
7. Transformer;
8. Modflator;
9. FK_1 [?channel 1 filter?];
10. Differential system;
11. Komp [compander];
12. FK_2;
13. Connecting box;
14. To the remote power transmission blocks;
15. Demodulator;
16. Generator equipment;
17. PTV [voice frequency ring receiver];
18. ZKS [expansion unknown];
19. VR [?ring relay?];
20. Ring receive;
21. Four-wire input;
22. 2, 4-wire output (or input).

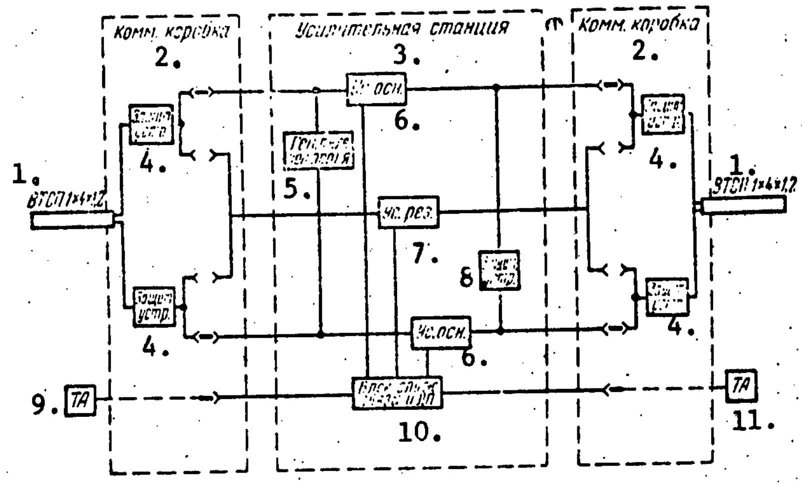


Figure 4.2.5. Block diagram of the repeater station of the KNK-6t equipment for a single quad cable (without AGC).

Key: 1. VTSP 1 x 4 x 1.2 [cable];
2. Connection box;
3. Repeater station;
4. Protective device;
5. Remote monitoring generator;
6. Main amplifier;
7. Standby amplifier;
8. Protective device;
9. Telephone handset;
10. Service communications and remote power block.
11. Telephone handset.

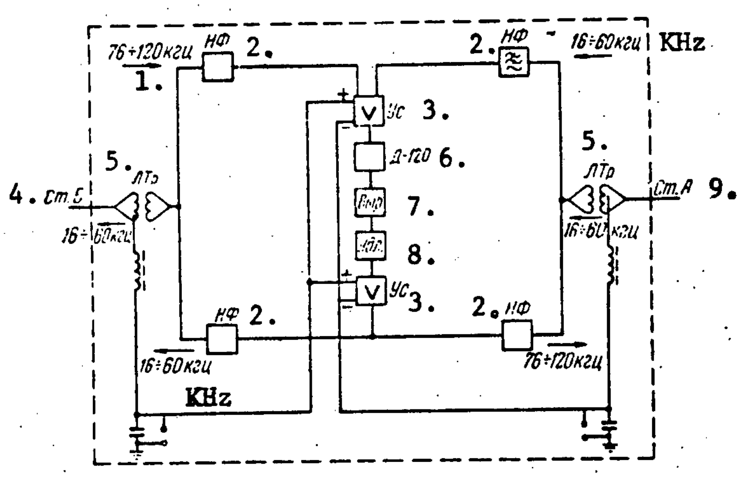


Figure 4.2.6. Block diagram of the unattended repeater station of the KNK-6t equipment for a single quad cable.

Key: 1. 76 - 120 KHz;
2. Routing filter;

[Key to Figure 4.2.6, continued]:

3. Amplifier;
4. Station B;
5. Line Transformer;
6. D-120 filter;
7. Equalizer;
8. Pad;
9. Station A.

4.3. The KV-12 12-Channel Transmission System

Figures 4.3.1. - 4.3.9.

Purpose:

Intended for multiplexing balanced, non-coil-loaded and intra-oblast' trunk cable lines. It is also employed for the organization of communications at the cable transitions to open wire communications lines using the V-12-2 equipment.

Type of Line:

Cables of the MKS and MK type with a capacity of 4 x 4 x 1.2 or 7 x 4 x 1.2; TDSB [cables] of various capacities.

Communications System: Single cable, two-band.

Electrical Characteristics:

Line frequency spectrum	36 - 84 KHz (B-A direction) 92 - 143 KHz (A-B direction)
Spectrum I	Direct arrangement of the channels;
Spectrum V	Inverse arrangement fo the channels.

Note: Inverse spectrum V should be employed in one of the systems operating via one quad. Suppression filters should be inserted in through-working circuits.

The number of channels which can be set up with the equipment via one two-wire circuit	12
The effectively transmitted passband	300 - 3,400 Hz
The number of telephone channels, used simultaneously for secondary multiplexing	See the introduction
The maximum length of a voice frequency retransmission section	800 km
The maximum service range	2,400 km
The nominal length of a repeater section of a trunk on an OUP--OUP [attended repeater station] section	$a_{nom}/\alpha_{t\,min}$, where a_{nom} is the attenuation of the repeater section at 143 KHz; $\alpha_{t\,min}$ is the attenuation factor of the cable at the minimum temperature.

The input impedance of the equipment from the line end:	
With line transformers	135 ohms and 180 ohms
Without the line transformers	135 ohms
The permissible deviation in the reflection factor	10%
The attenuation of two line transformers	0.1 Np
The residual channel attenuation at 800 Hz	0.8 Np
The nominal relative levels in the four wire section of a channel with respect to voice frequencies:	
At the input	-1.5 Np
At the output	+0.5 Np
The nominal relative transmit levels through the channels at the line amplifier output (with respect to power):	
Without skewing [of the frequency response] (can be used on short trunks up to 250 km)	0 Np
With skewing:	
At the upper frequency	+0.5 Np
At the lower frequency	-0.5 Np
The internal noise level in the spectrum of one telephone channel at NUP's and OUP's, reference to the line amplifier input	-15.7 Np
The psophometric noise power at the point with a relative zero level, which may be induced in the channels of the system:	
By two terminal stations with low frequency termination of the channels	500 pw, psoph.
By the line channel, for a length of 800 km	7,500 pw, psoph.
By two terminal stations with termination for the primary groups (HF retransmission)	233 pw, psoph.

Note: It is recommended that no more than one HF retransmission be organized on a low frequency retransmission section.

By the equipment for segregating four channels:	
In the straight-through channel	60 pw psoph.
In the channel for the segregation and insertion of the four channels	350 pw psoph.

Note: It is recommended that no more than two sets of segregation equipment be installed on a low frequency retransmission section, and in this case, the straight-through edge channels should not be used for through working.

The distribution of the noise power induced by the line channel in the upper channel of the system (thermal, nonlinear and linear)	1 : 1 : 2

The nonlinearity attenuation for the case of a zero level at the output (with respect to power) and a gain of 7.6 Np: a_{2h}	9 Np
a_{3h}	12 Np

The nominal attenuation of a repeater section at 143 KHz at the minimum ground temperature (cable only), a_{nom}, (for the case of inadequate compensation at 5° C):

MKB [cable]	6.3 Np
MKSB	5.3 Np
The following deviation in the attenuation over all repeater sections is permitted	±0.15 Np
The following deviation in the attenuation of up to [?50%? -poor copy] of the sections in the direction of an attenuation increase is permitted	0.3 Np

The frequency for noise computation in the design of the trunk	143 KHz

The gain of the station:

Maximum gain:

Equipment	84 KHz nepers	143 KHz nepers
Unattended and attended repeater stations	5.65	7.4
Terminal stations (the receive channel between the input to the equipment (or line) and the primary group output: the -0.6 Np point at the maximum setting of the AGC)	5.1	7.0

Minimum Gain (with the minimum pad attenuation in the negative feedback circuit, at the minimum setting of the level control, when the supplemental amplifiers are switched in):

Equipment	84 KHz nepers	143 KHz nepers
Unattended and attended repeater stations	3.75	5.0
Terminal station at the minimum setting of the AGC	3.4	4.8

The gain control in the negative feedback circuit of an NUP, OUP and OP:

Flat	(0.1 x 10) Np
Sloped lower group of frequencies	(0.1 x 12) Np
Sloped upper group of frequencies	(0.1 x 9) Np

The equalizing capability of the NUP, OUP and OP attenuation pads:

The difference in the attenuation of the variable slope network in the negative feedback circuit between frequencies of 36 (or 92) KHz and 84 (or 143) KHz:

The lower group of frequencies	(0.1 x 12 + 0.3) Np
The upper group of frequencies	(0.1 x 9 + 0.3) Np
The difference in the attenuation of the constant slope network in the negative feedback circuit between frequencies of 36 (or 92) KHz and 84 (or 143) KHz	0.8 Np
The attenuation of the routing filters at the following frequencies: 143 KHz	0.2 Np
84 KHz	0.6 Np
The level control system:	
In the OUP amplifiers	Manual, flat-slope type
In the OP amplifiers (AGC derived from the control frequencies): Flat type	80 or 92 KHz
Slope type	40 or 143 KHz
Amplifiers with AGC are located only at terminal stations, and those with manual control, every:	100 – 125 km
Ranges of gain control:	
For NUP and OUP amplifiers, between stages	0.3 and 0.5 Np
For terminal station AGC amplifiers:	
Flat type	1.6 Np
Slope type	0.7 Np
Between stages:	
Flat type	0.3 and 0.5 Np
Slope type	0.9 + 0.23 x 3 = 1.6 Np
The gain control by virtue of the supplemental amplifier of an NUP, OUP and OP, for the following groups of frequencies: upper	0, 1.7, 2.0 and 2.3 Np
lower	0, 1.5 Np
Phantom line (installed between supplemental and line amplifiers)	5 km
The attenuation of a phantom line at:	
143 (or 84) KHz	1.09 (or 0.83) Np
92 (or 36) KHz	0.87 (or 0.56) Np
Note: A phantom line is a special order item.	
Trunk equalizers are installed at the input to NUP and OUP amplifiers, having an attenuation at a frequency of 143 (or 84) KHz of	0.5 Np
Trunk equalizers should be installed as follows for the following groups of frequencies:	
Lower group, every	200 km
Upper group, every	100 km

The system for ringup via the HF channels	Voice frequency ringing at 2,100 Hz, the ringing level should be 0.7 Nep below the relative nominal transmit level.

The number of service links provided for servicing the trunk:

MSS [Trunk service communications link]	1
PSS-USS [combined station-to-station and sectional communications service link]	1

Climatic Operational Conditions:

Attended Stations. At temperatures of from +10 to +40° C, and a humidity of 75%; short term exposure to 80% at a temperature of +20° C.

Unattended Stations. At temperatures of from -5 to +40° C, and a relative humidity of 75%; short term exposure to 95% at a temperature of +20° C.

The Electrical Power Supply

Voltages:

Lower power supplies (OP and OUP):

Plate	220 volts ± 10% or 130 volts ± 10%
Filament	21.2 volts ± 3% or 24 volts ± 10%
Signaling	24 volts ± 10%.

Remote power, fed into the line (maximum)	450 volts
The voltage at the terminals of the NUP equipment, powered remotely for the case of the series connection of the remote power for up to two systems inclusively	135 volts ± 10%

Note: Required for powering the SIO [individual equipment rack] is 206 volts ± 3% and 21.2 volts ± 3%.

The number of NUP's in a section, working from the remote power supply voltage, using the following circuit configurations:

"Wire-ground"	up to four (without a backup)
"Wire-wire"	up to two (without a backup)
Where DC is induced at a voltage of more than ± 15 volts, a provision should be made in the equipment for the installation of compensators with a voltage control range of	± 70 volts

The permissible voltage (longitudinal e.m.f.) due to the influence of an AC electrified railroad (on a repeater section)

Long Term:

-- For the case of remote power in a "wire-ground" configuration and where one protective unit is inserted at an NUP and one at an OUP	50 volts eff.

-- The same, for the case of remote power using a "wire-wire" configuration	100 volts eff.
-- For the case of remote power in a "wire-ground" configuration, and where two protective units are inserted at an NUP and one at an OUP	300 volts eff.
Short Term:	
-- For the case of remote power in a "wire-ground" circuit configuration	750 volts eff.
-- For the case of remote power in a "wire-wire" circuit configuration	930 volts eff.

The permissible short term voltage (longitudinal e.m.f.) due to the influence of high voltage lines (on a repeater section):

With remote power via a "wire-ground" circuit	750 volts eff.
With remote power via a "wire-wire" circuit	930 volts eff.

The grounding device:

For an NUP when powered in a:	
"Wire-ground" circuit configuration	Two grounds: a working and a protective one
"Wire-wire" circuit configuration	One ground: a working (or protective) one
For OUP's and OP's	Three grounds: a work-one and two metering grounds.

Note: The magnitude of the resistance of each ground should be in accordance with GOST 464-68 [Stante Standard 464-68].

Current Consumption:

Terminal Station:

SGP for one system:	Plate	0.33 amps
	Filament	4.6 amps
	Signaling	1.2 amps (working)
SGP for two systems:	Plate	0.42 amps
	Filament	5.7 amps
	Signaling	1.4 amps (working)
SKO for one system:	Plate	0.24 amps
	Filament	4.2 amps
	Signaling	0.11 amps (emergency)
SKO for two systems:	Plate	0.48 amps
	Filament	8.4 amps
	Signaling	0.22 amps (emergency)

Intermediate Station:

PKVO for one system:	Plate	0.05 amps
	Filament	0.4 amps
	Signaling	0.4 amps (working)
PKVO for two systems:	Plate	0.1 amps
	Filament	0.8 amps
	Signaling	0.8 amps (working)
PKVN for one system:	Remote power supply battery	0.22 amps
PKVN for two systems:	Remote power supply battery	0.26 amps

Type of Vacuum Tubes Used: 6Zh1PYe (used as an exception in the generator equipment is a 6P3Ye tube).

Equipment Complement

Terminal Station:

SGP. The rack of group converters. It is manufactured in eight variants depending on: the number of systems (for one or two systems); the transmission direction (SGP-A or SGP-B); and on the VKO panel used (input impedance of 180 ohms or 135 ohms).

Supplemental Equipment. Stipulated when ordering: The remote power transmit panel (one or two blocks); the VKO [cable entrance equipment] panels with an input impedance of 135 or 180 ohms; the suppression filters ("plug" filter); the switcher for switching the amplifier channels (from main to standby); the block of low frequency phantom lines for three to five km; the block of HF phantom lines for three to five km; an instrument of the PIEL or KIP-2 type; the row signaling transparency. The KGP set for completing the equipment complement of the SGP racks with one to two systems (manufactured to match the transmit direction: KGP-A or KGP-B).

Notes:
1. Regardless of the number of systems, the SGP rack provides the internal rack wiring for two systems.
2. The type of VKO panels is stipulated when ordering.
3. SGP racks for one system are manufactured only for line spectrum variant I, while the KGP sets are manufactured only for line spectrum variant V.

SIO. The individual equipment set (see section 7).

SS-3 or SS-4. The unitized, switching, service communications callup equipment, or the SSS-7 and SSS-8 (see section 11).

SKO. The rack of compander equipment for interference reduction in the channels. It is put together as a set for 1 - 2 systems with the capability of installing up to 4 systems. (Not manufactured at the present time).

The Attended Intermediate Station:

PKVO. The rack of intermediate service amplifiers. Manufactured in four variants depending on: the number of systems (one or two systems); on the VKO panel employed (input impedance of 180 or 135 ohms).

The supplemental equipment. Stipulated when ordering: the VKO panels with input impedances of 135 or 180 ohms; the remote power transmission panel (one or two blocks); the HF line equalizer, LV-0.3; the block of low frequency phantom lines for 5 km; the block of HF phantom lines for 5 km; suppression filter ("plug" filter). The complex of amplifier equipment, KPKV-O, for filling out the equipment complement of the PKV-O rack (the type of VKO panels is stipulated when ordering).

Notes: 1. The set of amplifier equipment, KPKV-O, is supplied as a separate product.
2. The delivery of the panel of DK-30 filters for the PKV-O racks, and the set of amplifier equipment, is stipulated when ordering.
3. When organizing channel segregation, supplemental equipment is required in addition to the PKV-O and SVK racks: an SVK connecting panel, transmit line amplifiers, pads and transformers.

The Unattended Intermediate Station

PKV-N. The unattended rack of intermediate amplifiers. It is manufactured in two variants, depending on the type of VKO panels employed (with an input impedance of 180 ohms or 135 ohms). The PKV-N rack is manufactured for one system.

The supplemental equipment. Stipulated when ordering: the rack frame; the panel of through-working power supply filters; suppression filter ("plug" filter); block of low frequency phantom lines for 3 - 5 km; block of HF phantom lines for 3 - 5 km; the block of LV-0.3 (nepers) low frequency line equalizers; the block of HF LV-0.3 (nepers) line equalizers; the D-14 filter. The set of amplifier equipment, KPKV-N, for filling out the equipment complement of the PKV-N rack.

Notes: 1. The delivery of the panel of DK-30 filters and the set of amplifier equipment is stipulated when ordering.
2. Data on the D-14 suppression filters are given in section 13.

Construction:

SGP, PKVO. Rack filled on both sides. Dimensions: 2,512 x 648 x 478 mm.

PKV-N. Rack filled on one side. Dimensions: 2,500 x 648 x 250 mm.

SKO. Rack for up to two systems filled on one side, and for 3 - 4 systems, filled on both sides. Dimensions: 2,512 x 648 x 380 mm.

Weight and Cost

Equipment	Weight, kg	Price, rubles
SGP-A for one system	290	2,497
SGP-A for two systems	400	3,628
SGP-B for one system	290	2,514
SGP-B for two systems	400	3,686
PKVO for one system	190	1,600
PKV-N for one system	160	1,132
KSGP-A for one system	120	1,086
KSGP-B for one system	120	1,124
KPKV-O for one system	130	888

Weight and Cost, [continued]:	Weight, kg	Cost, rubles
KPKV-N for one system	100	724
Remote power transmit panel	5.5	39
Panel of DK-30 filters	9	113
SVK connection panel	8	1,141

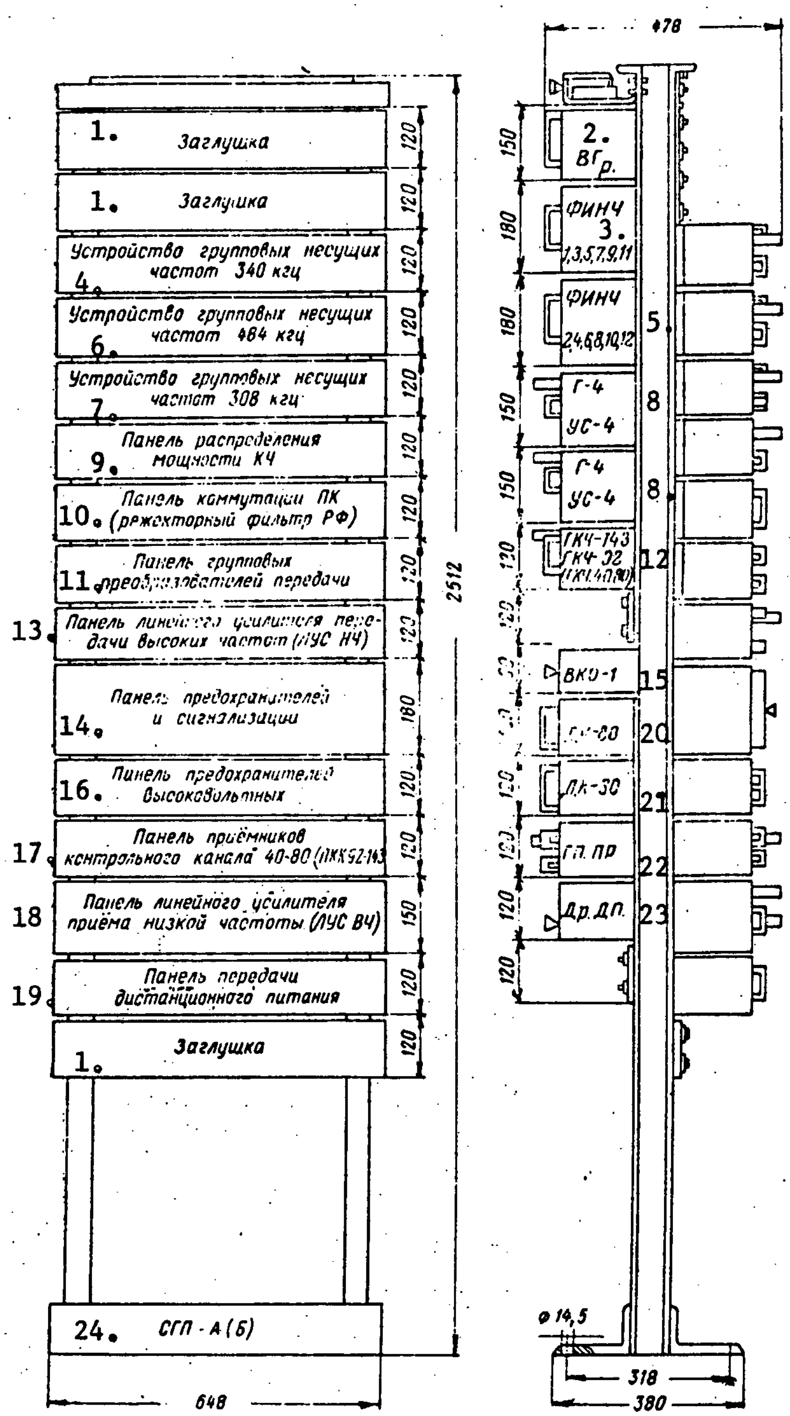


Figure 4.3.1. The placement of the equipment in the rack of group converters, SGP, of the KV-12 equipment for one system.

[Key to Figure 4.3.1]:

1. Blank panel;
2. Input terminal blocks;
3. FINCh [individual carrier frequency filters (odd)];
4. 340 KHz group carrier frequency unit;
5. FINCh [individual carrier frequency filters (even)];
6. 484 KHz group carrier frequency unit;
7. 308 KHz group carrier frequency unit;
8. G-4, US-4 [4 KHz generator, 4 KHz amplifier];
9. Control frequency power distribution panel;
10. PK commutating panel (RF rejection filter);
11. Panel of group transmit converters;
12. GKCh-143, GKCh-92 (GKCh 40, 80) [143 and 92 KHz (or 40 and 80 KHz) control frequency generators];
13. Low frequency transmit line amplifer panel (LUS NCh);
14. Fuse and signaling panel;
15. VKO-1 [cable input unit 1];
16. High voltage fuse panel;
17. Panel of control channel receivers, 40 - 80 [KHz] (or PKK 92 - 143);
18. High frequency receive line amplifier panel (LUS VCh);
19. Remote power transmit panel;
20. DK-88 filter;
21. DK-30 filter;
22. GP. PR [?group converters, receive?];
23. Remote power supply chokes;
24. SGP-A (or B).

[Key to Figure 4.3.1 (page 239)]:

1. UGN-540 [540 KHz group carrier amplifier?];
2. Input terminal block;
3. FINCh [individual carrier frequency filters (odd)];
4. RKCh [?control frequency power distribution unit?];
5. FINCh (even);
6. G-4, Us-4 [4 KHz generator, 4 KHz amplifier];
7. G-4, Us-4;
8. GK4-143, GK4-92 [unknown types of 4 - 143 and 4 - 92 KHz generators];
9. Connection panel;
10. GPP per. [unknown type of group transmit unit];
11. High frequency line amplifier;
12. Fuse and signaling panel;
13. PR VV [expansion unknown];
14. PKK [control channel receiver];
15. Low frequency line amplifier;
16. Remote power transmission panel;
17. Blank panel;
18. Control channel receiver;
19. Low frequency line amplifier;
20. VKO [cable entrance unit];

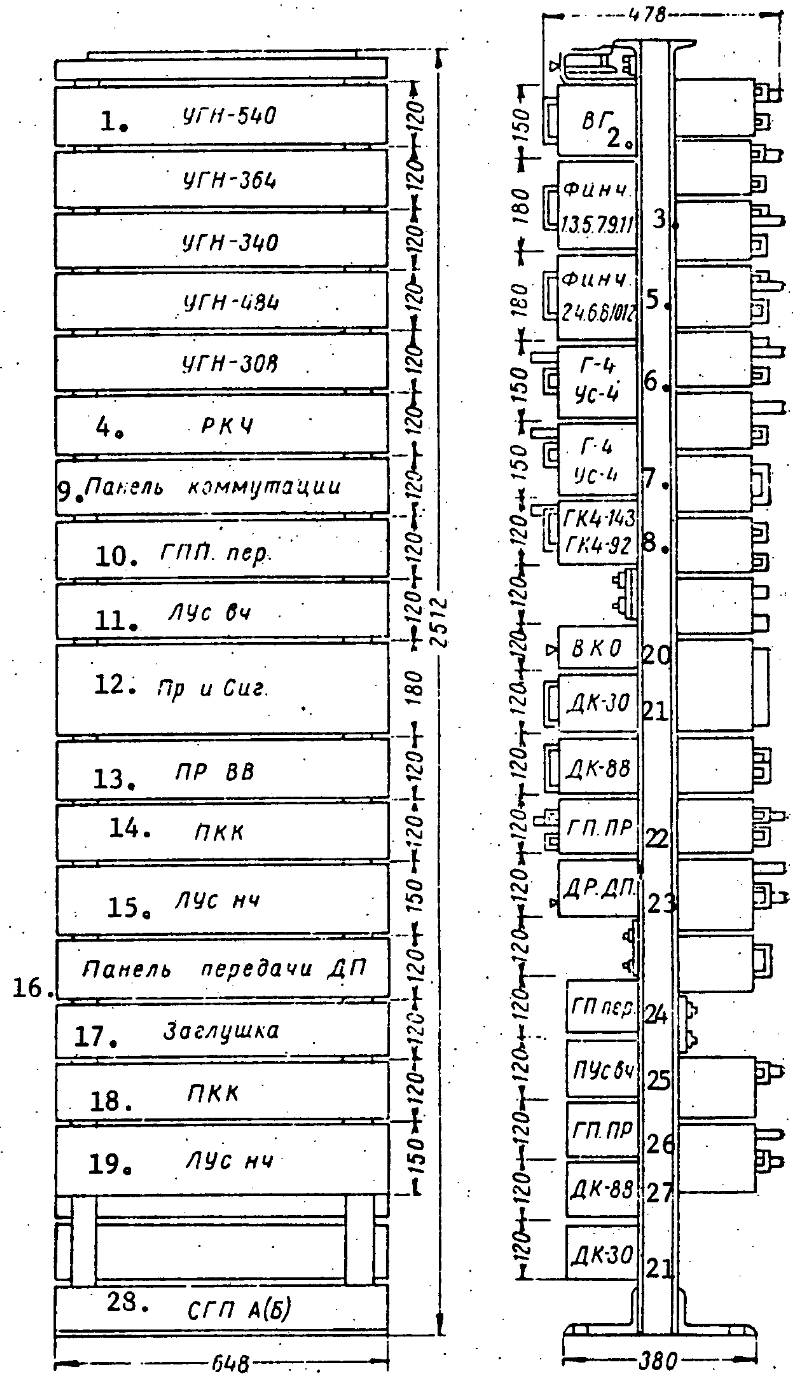


Figure 4.3.2. The equipment placement in the rack of group converters, SGP, of the KV-12 equipment for two systems.

[Key to Figure 4.3.2, continued from page 238]:

21. DK-30 filter;
22. GP PR [expansion unknown];
23. DR. DP [?remote power transmission chokes?];
24. GP Per [?transmit group converter?];
25. PUs VCh [unknown type of high frequency amplifier];
26. GP Pr;
27. DK-88 filter;
28. SGP A (or B).

[Key to Figure 4.3.3, page 241]

1. High frequency line amplifier;
2. Low frequency line amplifier;
3. Control frequency meter;
4. PK [?monitor panel?];
5. PR [?distribution panel?];
6. Location for the installation of the DK-30 filters;
7. Location for the installation of the DK-88 filter panel;
8. Location for the installation of the high frequency line amplifier panel;
9. Location for the installation of the low frequency line amplifier panel;
10. Location for the installation of the DK-88 filter panel;
11. Location for the installation of the DK-30 panel;
12. VG [input terminal block];
13. VKO-I [cable entrance unit one];
14. VKO-II;
15. DR. DP [unknown type of remote power supply unit];
16. VKO-3;
17. Pr. VV [expansion unknown];
18. PDP-1, PDP-5 [remote power transmission units 1 and 5].

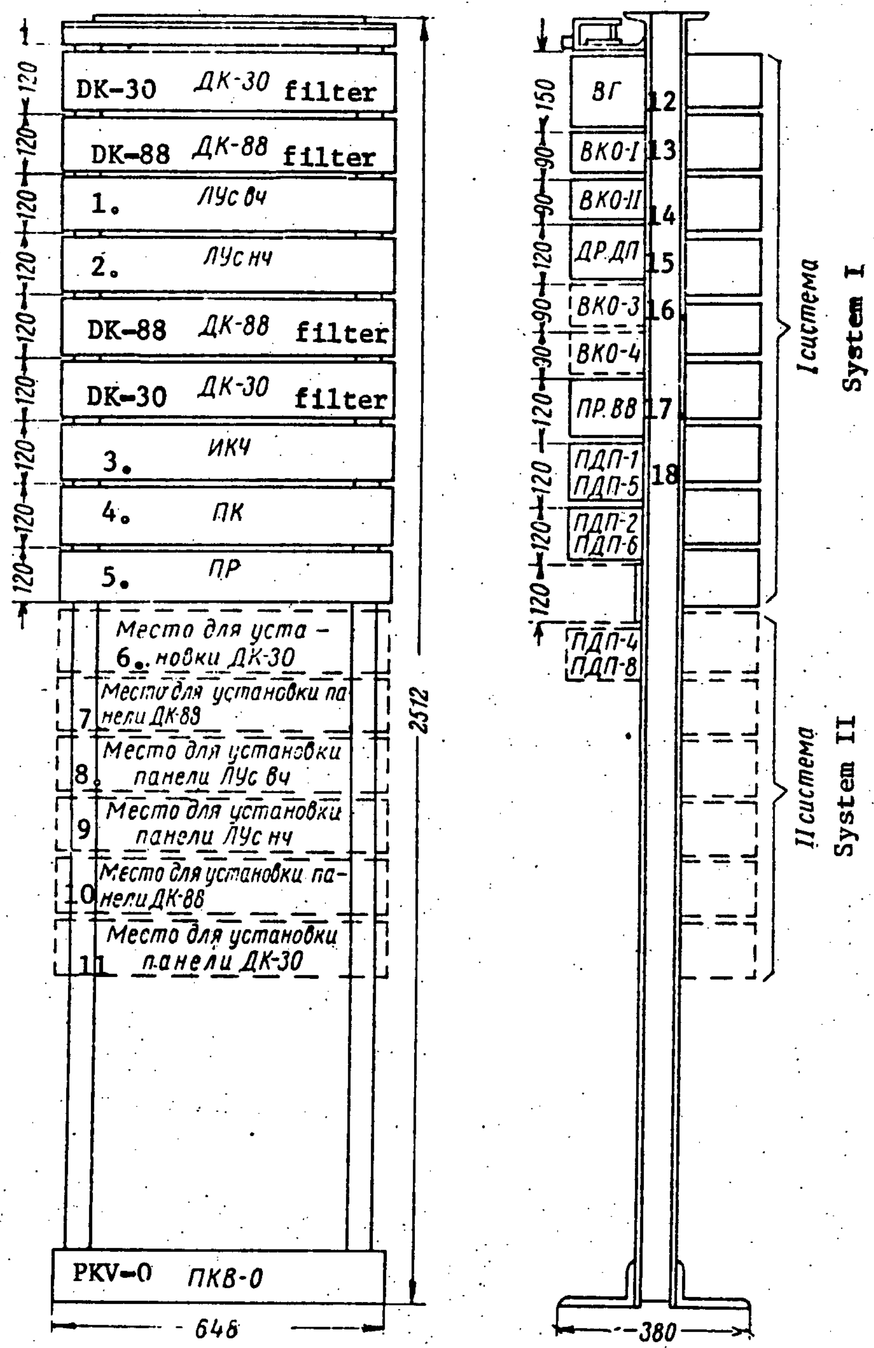


Figure 4.3.3. The placement of the equipment in the PKV-0 attended intermediate amplifier station of the KV-12 equipment for 1 - 2 systems.

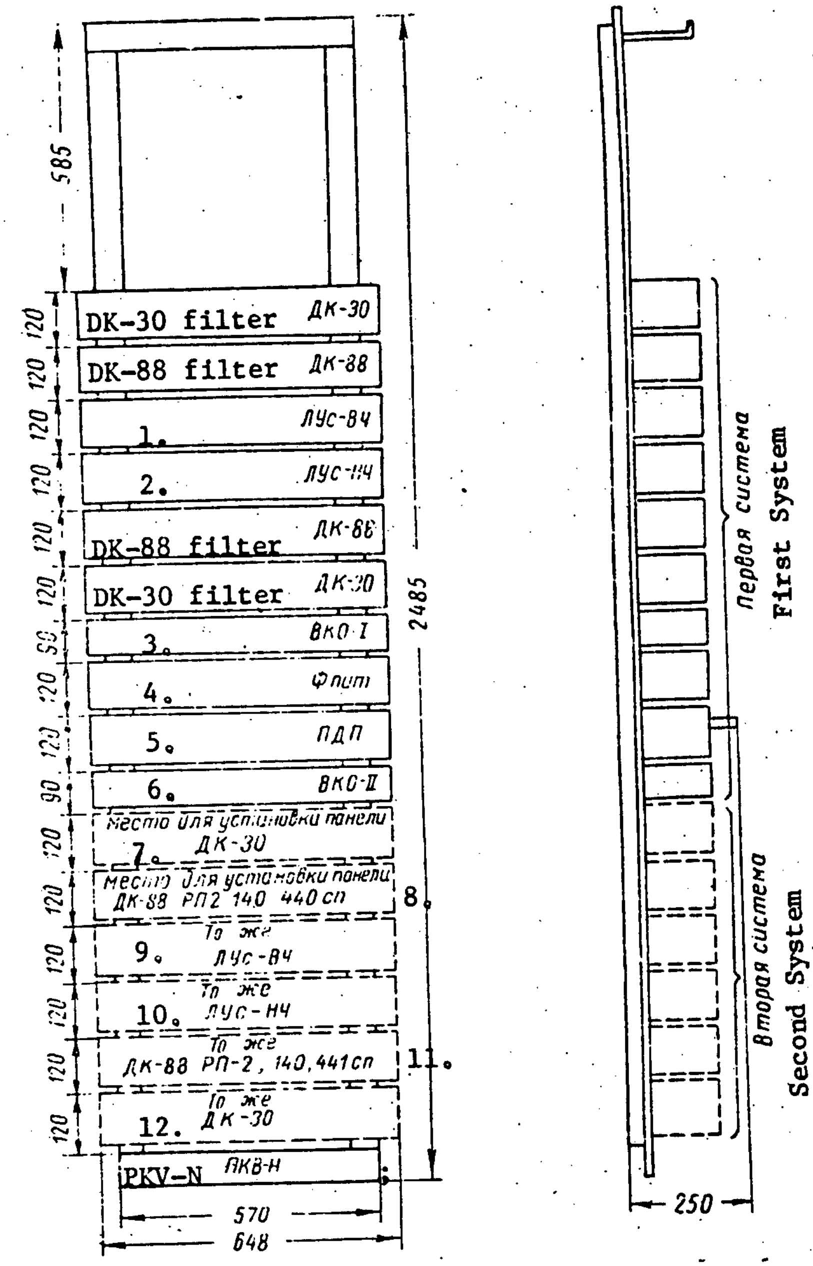


Figure 4.3.4. The placement of the equipment in the unattended intermediate amplifier station (PKV-N) of the KV-12 equipment for 1 - 2 systems.

Key: 1. High frequency line amplifier;
2. Low frequency line amplifier;

[Key to Figure 4.3.4, continued]:

3. Cable entrance unit 1;
4. [?power supply filter?];
5. PDP [remote power transmit unit];
6. Cable entrance unit 2;
7. Location for the installation of the DK-30 filter panel;
8. Location for the installation of the DK-88, RP2, 140, 440 sp panels;
9. The same, HF line amplifiers;
10. The same, LF line amplifiers;
11. The same, DK-88, RP-2, 140, 441 sp;
12. The same, for the DK-30 filters.

[Key to Figure 4.3.5, page 244]

1. Input terminal blocks;
2. Compressor, expander;
3. Fuses;
4. Signaling.

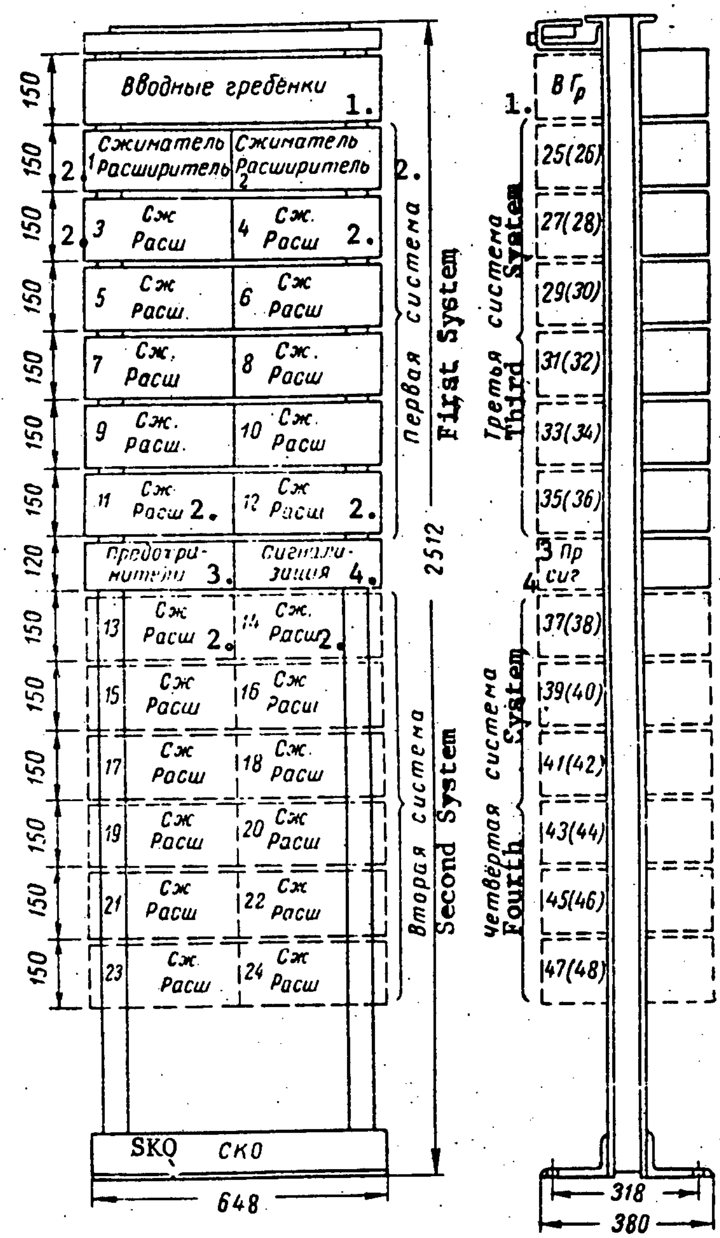


Figure 4.3.5. The placement of the boards in the compander equipment rack, SKO, of the KV-12 equipment for 1 - 4 systems.

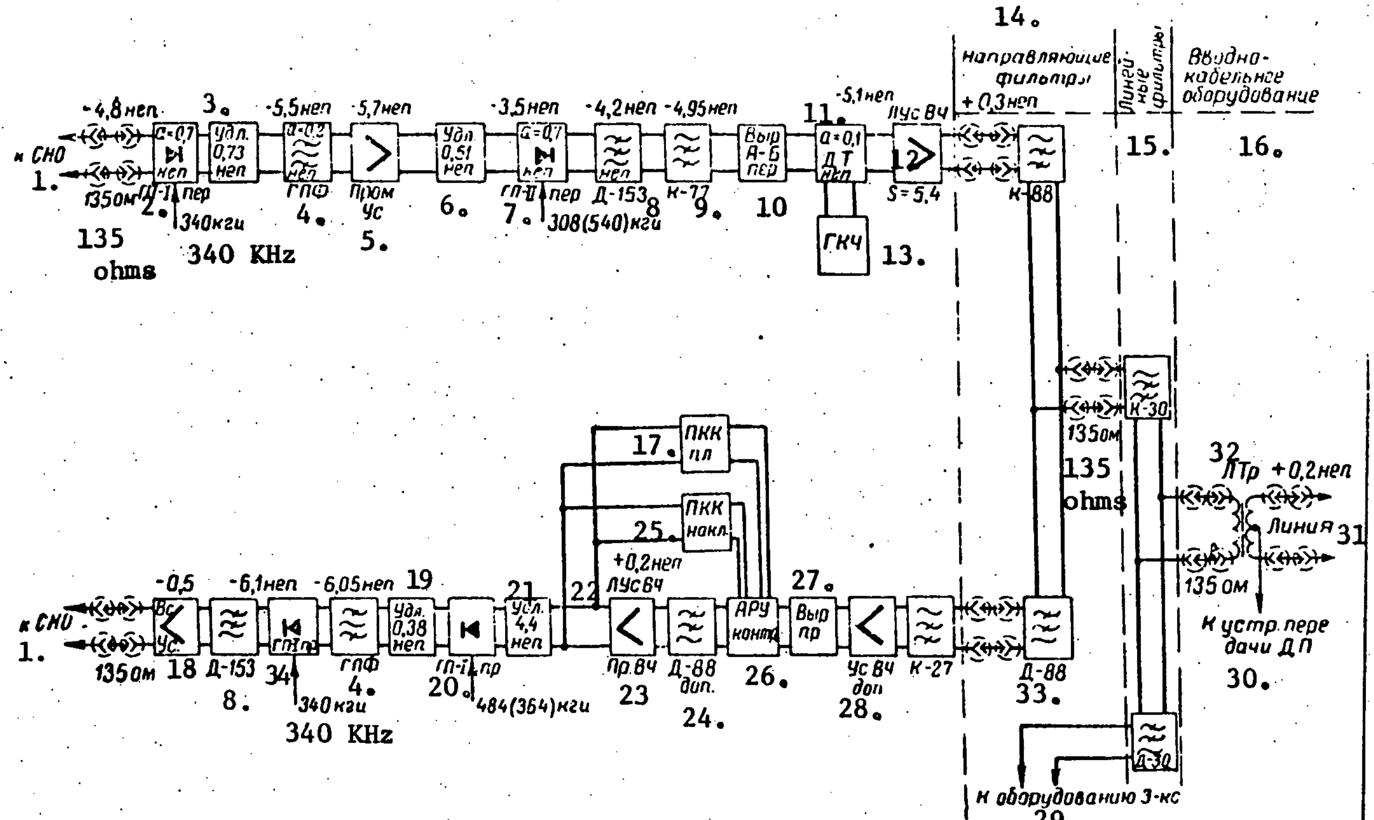


Рис. IV.3.6. Блок-схема стойки групповых преобразователей СГП-А аппаратуры КВ-12

Figure 4.3.6. Block diagram of the SGP-A rack of group converters of the KV-12 equipment.

Key:
1. To the SNO;
2. Group converter 1, transmit;
3. 0.73 neper pad;
4. Group bandpass filter;
5. Intermediate amplifier;
6. 0.51 neper pad;
7. Group converter 2, transmit;
8. D-153 filter;
9. K-77 filter;
10. A-B transmit equalizer;
11. DT [?differential transformer?], a = 0.1 Np;
12. HF line amplifier;
13. GKCh [control frequency generator];
14. Routing filters;

[Key to Figure 4.3.6, continued]:

15. Line filters;
16. Cable entrance equipment;
17. Flat type control channel receiver;
18. [?auxiliary amplifier?];
19. 0.38 neper pad;
20. Group converter 1, receive;
21. 4.4 neper pad;
22. High frequency line amplifier;
23. Pr. VCh. [?high frequency receiver?];
24. Supplemental D-88 filter;
25. Slope type control channel receiver;
26. AGC control;
27. Receive equalizer;
28. Supplemental HF amplifier;
29. To the 3 channel system equipment;
30. To the remote power transmit unit;
31. Line;
32. Line transformer;
33. D-88 filter.

[Key to Figure 4.3.7, page 247]:

1. Rejection filter;
2. Group converter 1, transmit, a = 0.9 nepers;
3. a = 0.7 neper pad;
4. GPF [group bandpass filter];
5. Intermediate amplifier;
6. a = 0.5 neper pad;
7. Group converter 2, transmit, a = 0.9 nepers;
8. D-153 filter;
9. B - A transmit equalizer;
10. Control frequency generator;
11. Differential transformer;
12. HF transmit line amplifier;
13. Routing filters;
14. Line filters;
15. Cable entrance equipment;
16. Flat type control channel receiver;
17. Slope type control channel receiver;
18. Line transformer;
19. To the remote power transmit unit;
20. [?auxiliary amplifier?];
21. D-153 filter;
22. Group converter 2, receive;
23. Group bandpass filter;
24. 0.38 neper pad;
25. Group converter 1, receive;
26. Line amplifier;

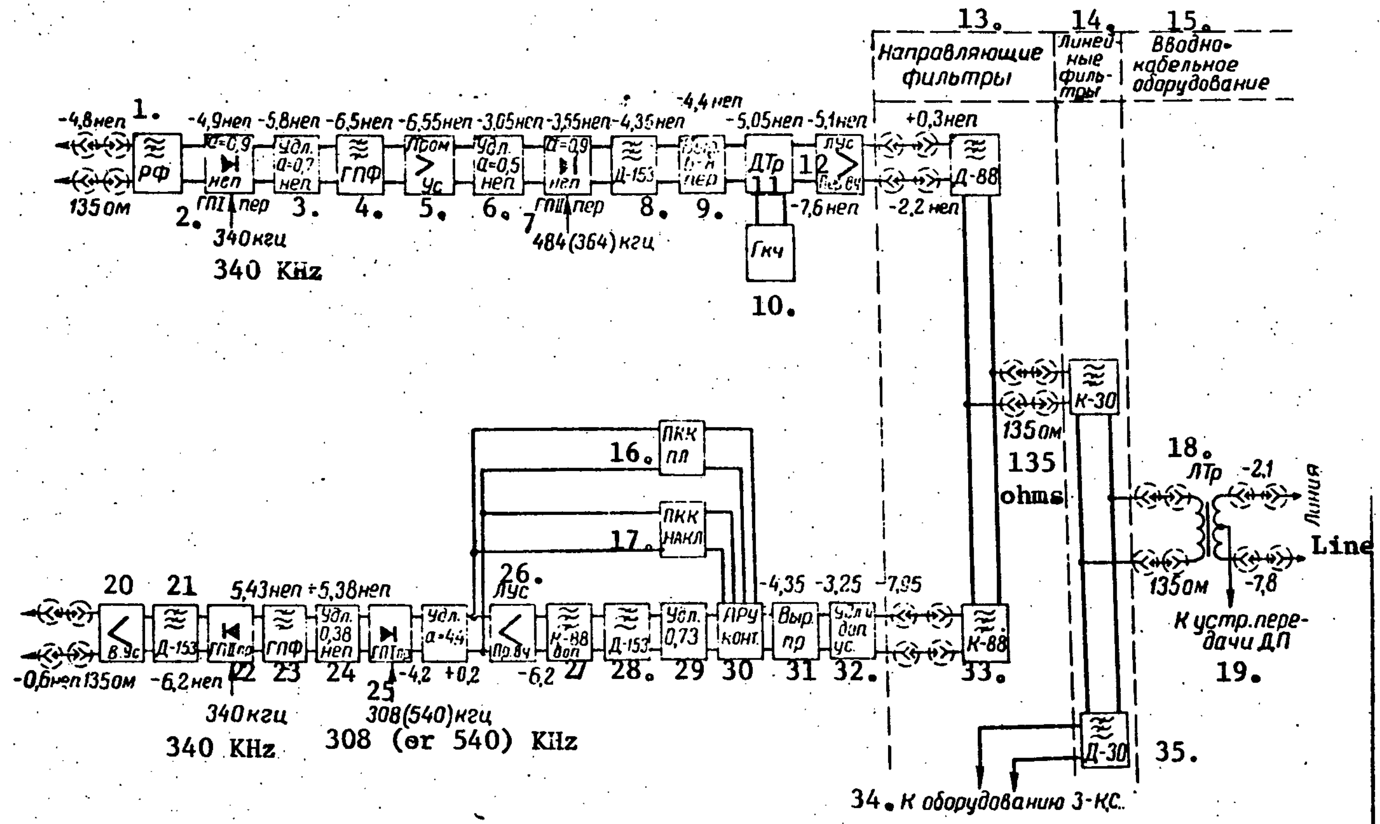


Figure 4.3.7. Block diagram of the SGP-B rack of group converters of the KV-12 equipment.

[Key, continued from preceding page]:

27. Supplemental K-88 filter;
28. D-153 filter;
29. 0.73 neper pad;
30. AGC control;
31. Receive equalizer;
32. Pad and supplemental amplifier;
33. K-88 filter;
34. To the three channel system equipment;
35. D-30 filter.

4.4. The K-24-2 24-Channel Transmission System

Figures 4.4.1 - 4.4.17.

Purpose:

Intended for multiplexing balanced, noncoil-loaded cables where the K-24-60 and K-24p-2m amplifiers are used in NUP's [unattended repeater stations] (the K-24p-2m has been taken out of production).

Type of Line:

MKS or MKSA cable with styroflex-cord insulation, and MK cable with paper-cord insulation having a capacity of 4 x 4 x 1.2 or 7 x 4 x 1.2, when K-24-60 amplifiers are used at the NUP's, and MKPV 1 x 4 x 1.2 when K-24-60 amplifiers are used at an NUP, and MKPV (or MKV) 1 x 4 x 1.2 when K-24p-2m amplifiers are employed at the NUP's.

Communications System: Two-cable, single-band.

Electrical Characteristics:

Line spectrum	12 - 108 KHz
Number of channels which can be organized on one four-wire circuit	24
The effectively transmitted passband	300 - 3,400 Hz
Secondary multiplexing capability	see the introduction
The maximum length of a retransmission section for voice frequencies for systems using the following amplifiers at NUP's:	
K-24-60	2,500 km (4 x 4 x 1.2 cable)
K-24p-2m	1,000 km (1 x 4 x 1.2 cable)
The maximum number of retransmission sections (when the K-24-60 and K-24p-2m amplifiers are used at the NUP's	5
The maximum communications range for systems which use the following amplifiers at the NUP's:	
K-24-60	12,500 km (4 x 4 x 1.2 cable)
K-24p-2m	5,000 km (1 x 4 x 1.2 cable)
The residual attenuation of a channel at 800 Hz	0.8 Np
The nominal relative voice frequency levels of the four-wire section of a channel:	
At the input	-1.5 Np
At the output	+0.5 Np

The nominal relative transmit level through the channels at the line amplifier output (with respect to power):

a) For OUP's and NUP's for the case of K-24-60's at the NUP's

-- Without skewing [of the frequency response] (can be used on short trunks of up to 250 km)	- 0.15 Np
-- With skewing with respect to the 24th channel	+ 0.15 Np
-- The same, with respect to the first channel	- 0.35 Np

b) For OUP's and NUP's for the case of K-24p-2m's at the NUP's:

-- Without skewing	- 10. Np
-- With skewing with respect to the 24th channel	- 0.8 Np or - 0.7 Np
-- The same, with respect to the first channel	- 1.9 Np or - 1.3 Np

Note: At OUP's [attended repeaters], the levels are adjusted in accordance with paragraph (a), and the quantities indicated in paragraph (b) are set by means of supplemental pads, which can be inserted at the output of the amplifiers.

The internal noise level in the spectrum of one telephone channel, referenced to the line amplifier input, for links which use the following amplifiers:

K-24p-2m:	At NUP's	-15.3 Np	
	At OUP's	-15.0 Np	
K-24p-2m:		108 KHz	12 KHz
	At NUP's	-14.8 Np	-14.5 Np
	At OUP's	-15.0 Np	-15.0 Np

The psophometric noise power at the point with relative zero level, induced in the channels of the system by:

-- Two terminal stations with a low frequency termination of the channels	500 pw psoph.
-- Line channel with a length of 2,500 km	7,500 pw psoph.
-- With a length of 1,000 km (where the K-24p-2m NUP is used)	3,000 pw psoph.
-- Two terminal stations with primary group termination (HF retransmission)	150 pw psoph

Note: It is recommended that no more than one HF retransmission be organized on a low frequency retransmission section when using the existing through working equipment.

-- Channel segregation equipment (for 4 and 12 channels) in the following channels:

The through channels, for 12 channels	30 pw psoph.
The segregation and insertion of 12 channels with voice frequency termination	280 pw psoph.
The segration and insertion of 4 channels	350 pw psoph.

Note: At OUP's, where a provision is made for channel isolation, amplifiers having three-frequency AGC should be installed. It is recommended that no more than three sets of isolation equipment be installed on a low frequency retransmission section. In this case, the edge, straight-through channels should not be used for through-working.

The distribution of the noise power, induced by the line channel in the upper channel of a system (thermal, nonlinear and linear), at NUP's with the following amplifiers:	
K-24-60	1 : 1 : 2 (4x4x1.2 or 7x4x1.2 cable)
K-24p-2m	1 : 1 : 1 (1x4x1.2 cable).
The attenuation of nonlinearity at the zero level at the output at 108 KHz (with respect to power) for the following NUP amplifiers:	
K-24-60 at a gain of 7.0 Np	
a_{2h}	9 Np
a_{3h}	12 Np
K-24p-2M:	
a_{2h}	8.5 Np
a_{3h}	11.0 Np
With two- and three-frequency AGC at a gain of 7.0 Np (OUP)	
a_{2h}	9 Np
a_{3h}	12 Np
The nominal attenuation of a repeater section at 108 KHz at the maximum ground temperature (cable only), a_{nom}, for links using the following amplifiers:	
K-24-60	6.55 Np
K-24p-2m	3.90 Np

Notes: 1. A deviation of ±0.15 Np is permitted on all repeater sections;

2. A deviation of up to 25% of the sections by 0.3 Np in the direction of an attenuation increase is permitted for the K-24-60 amplifiers (only for MKSB cable), and by 0.35 Np for up to 50% of the sections for the K-24p-2m amplifiers.

   Attenuations curtailed by just this amount should correspond to each lengthened segment in a section (three sections for the K-24-60 NUP, and one section for the K-24p-2m NUP); lengthened sections should not follow one another. The number of shortened sections using phantom lines should be no greater than three. It is desirable to locate shortened sections close to the OUP, and lengthened sections should not be located one after the other.

The nominal length of a repeater section of a trunk on an OUP--OUP section	$a_{nom}/\alpha_{t\ max}$

Where a_{nom} is the nominal attenuation of the repeater section at 108 KHz; $\alpha_{t\ max}$ is the attenuation factor of the cable at the maximum ground temperature;

The nominal length of a repeater section, and the permissible deviations at $t_{max} = +16°$ C:

-- When using K-24-60 amplifiers in the NUP's:

MKSB 4 x 4	33.2 ± 0.76 km
MKSB 7 x 4	33.3 ± 0.76 km
MKB 4 x 4	31.4 ± 0.72 km
MKSA 4 x 4	34.2 ± 0.7 km

-- When using K-24p-2m amplifiers in the NUP's:

MKPV	19.5 ± 0.75 km

The input impedance of the equipment from the line end, for links which use the following amplifiers at the NUP's:

-- K-24-60:	With line transformers	180 ohms
	Without line transformers	135 ohms
	The permissible deviation in the reflection factor	$p \leq 0.15\sqrt{108/f_1}$, but no more than 0.3
	The attenuation of two line transformers	0.12 Np
-- K-24p-2m:	With line transformers	145 ohms
	Without line transformers	135 ohms
	The permissible deviation in the reflection factor	$p \leq 0.15\sqrt{108/f}$, but no more than 0.25
	The attenuation of two line transformers	0.05 Np

The gain of a station at a frequency of 108 KHz:

Maximum gain:

a) For NUP stations (with ground reference AGC) using the following amplifiers:

K-24-60 — 7.25 Np

Note: The gain is indicated for the case where a 2.3 Np pad is inserted in the negative feedback circuit of the line amplifier at the maximum setting of the ground referenced AGC, as well as when all line equalizers are inserted at the input to the line amplifier.

K-24p-2m (with ground referenced AGC at the maximum setting) — 4.3 Np

b) For stations with two- and three-frequency AGC (attended repeaters) — 8.3 Np

Note: The gain is indicated for the case where the flat type AGC control is in the ninth position, the pad and potentiometer are switched out from the input, and when all line equalizers are inserted and the attenuation of the pads in the negative feedback circuit is 1.7 Np.

Minimum Gain (at the minimum pad attenuation in the negative feedback circuit: the AGC control is in the maximum setting):

a) For NUP stations (with ground referenced AGC) using the following amplifiers:

K-24-60	5 Np
K-24p-2m	3.5 Np

b) For stations with two- and three-frequency AGC (attended repeaters) — 6.4 Np

Note: The given gains are indicated for conditions stipulated in the "maximum gain" paragraph. Only the pad in the negative feedback circuit is changed.

The gain is adjusted in the negative feedback circuit in steps of: — 0.1 Np each

The gain control using the potentiometer and pads installed at the input to the amplifiers:

-- NUP's with K-24-60 amplifiers, with pads at the amplifier input	0.3 x 7 = 2.1 Np
-- NUP's with K-24p-2m amplifiers, with pads between the amplifying stages	0.1 x 8 = 0.8 Np
-- OUP's with a pad at the amplifier input	0.1, 0.3 and 0.7 Np

The equalizing capability of the amplifiers:

The difference in the attenuations of the constant slope network in the negative feedback circuit between frequencies of 103 and 17 KHz:

-- For NUP's with K-24-60 amplifiers (with ground referenced AGC)	0.5 Np
-- For NUP's with K-24p-2m amplifiers (with ground referenced AGC)	0.62 x 2 Np
-- For OUP's with amplifiers with two- and three-frequency AGC	1.2 Np

The difference in the attenuation of the line equalizers at frequencies of 107 and 17 KHz:

a) For NUP's with K-24-60 amplifiers having ground referenced AGC:

	MKB	MKSB
LV_1 [line equalizer 1]	0.4-1.8 Np	0.4-1.6 Np
LV_2	1.6 Np	1.6 Np

b) For NUP's with K-24p-2m amplifiers having ground referenced AGC:

Line equalizers	0.27, 0.45, and 0.63 Np

c) For OUP's with amplifiers having two- and three frequency AGC:

	MKB	MKSB, MKPV
LV_1 [line equalizer 1]	0.4 - 1.8 Np	0.4 - 1.6 Np
LV_2	0.6 Np	1.6 Np

Note: Line amplifiers cannot be used without line equalizer 2.

The line equalizer attenuation at 103 KHz:

-- For an NUP with K-24-60 amplifiers	0.25 Np
-- For an NUP with K-24p-2m amplifiers	0.10 Np
-- For an OUP	0.25 Np

The AGC system:

In NUP amplifiers (ground referenced)	Flat type for the K-24-60 frequency dependent for the K-24p-2m
In OUP amplifiers (AGC using control frequencies)	Electromechanical, frequency dependent, two- and three-frequency.

Control Frequencies:

Slope	16 KHz
Curvilinear	64 KHz
Flat	104 KHz

Amplifiers having the following types of AGC are located as follows:

With ground referenced AGC	At each NUP
With two-frequency AGC (at each OUP) for links which use the following amplifiers at NUP's:	
K-24-60	Every 210 km
K-24p-2m	Every 280 - 300 km
With three-frequency AGC	Every 600 - 700 km

The gain control range limits:

-- For K-24-60 NUP amplifiers with ground referenced AGC (when the ground temperature changes from -2 to +18° C)	± 0.07 Np (MKB) and ± 0.15 Np (MKSB) [cable]
-- For K-24p-2m NUP amplifiers under the same conditions, at the following frequencies:	
12 KHz	± 0.06 Np
108 KHz	± 0.08 Np
-- For amplifiers with two-frequency AGC:	
Flat type	± 0.60 Np
Slope type (12 KHz)	± 0.50 Np

— For amplifiers with three-frequency AGC:

Flat type	$\pm$ 0.6 Np
Slope type (12 KHz)	$\pm$ 0.5 Np
Curvilinear (60 KHz)	$\pm$ 0.4 Np

Note: To be taken into account in the project planning is the imprecision the AGC control with respect to the control freqeuncy of $\pm$ 0.07 Np (a level reduction over the entire by 0.07 Np at the maximum ground temperature).

The inaccuracy in the ground referenced AGC equalization on OUP-OUP sections	$\pm$ 0.30 Np
The length of a ground referenced AGC cable:	
For a temperature drop of from -2 to +18° C	No more than 14 m
For some other ground temperature drop, for the following number of NUP's:	
Up to four	No more than 14 m
More than four	10 m

Note: The cable should be specially balanced so that the values of the crosstalk attenuation between the circuits is no less than 9.5 nepers.

Phantom lines at the input to the amplifiers are installed as follows:

At NUP's with K-24-60 amplifiers	Every 5 km
The phantom line attenuation at 108 KHz	0.97 Np
The phantom line attenuation at 12 KHz	0.41 Np
At NUP's with K-24p-2m amplifiers	Every 2.9 x 2 km
The phantom line attenuation at 108 KHz	0.96 Np
The phantom line attenuation at 12 KHz	0.48 Np
At OUP's	Every 5 km
The phantom line attenuation at 108 KHz	0.97 Np
The phantom line attenuation at 12 KHz	0.41 Np

Note: The phantom line is specified in a special order.

The attenuation of trunk equalizers at the input to NUP amplifiers at 108 KHz, for the following amplifiers:

K-24-60	0.50 Np
K-24p-2m	0.30 Np

Trunk equalizers should be installed as follows for NUP's having the following amplifiers:

K-24-60	Every 100 - 150 km
K-24p-2m	Every 70 - 80 km

Notes: 1. A trunk equalizer (constant and variable) for aligning the channel is a special order item.

2. No less than two variable trunk equalizers should be ordered for each OUP.
3. No provision is made in the equipment for the use of cosine variable equalizers.

The ringing system via the HF channels	Voice frequency ringing at 2,100 Hz
The number of service communications links:	
For multiquad cables:	
Trunk operator service communications link, MSS	1
Station to station operator service communications link, PSS	2
Sectional service communications link, USS	1
For single quad cables:	
Trunk operator service communications link, MSS	1
Combined station to station and sectional operator service communications link, PSS-USS	1
The number of remotely power NUP's between two power supply stations:	
For NUP's with K-24-60 amplifiers when using both cables in a:	
"Wire-wire" circuit configuration	4
"Wire-ground" circuit configuration	8

Note: Where it is necessary to disengage one of the cables, only 50% of the links will be preserved.

For NUP's with K-24p-2m amplifiers in a "wire-wire" circuit configuration	Up to 14 (7 NUP's each from each end)
In the presence of induced DC at a voltage of more than ± 15 volts, a provision should be made in the equipment for the installation of compensators with voltage control ranges of (for links with the K-24-60 amplifiers)	$\pm$ 70 volts

Notes: 1. A "wire-wire" remote power circuit configuration should be used in the presence of DC induction of more than $\pm$ 70 volts.

2. No provision is made for the installation of compensators for links with K-24p-2m amplifiers at the NUP's ("wire-wire" power supply circuit).

The permissible voltage (longitudinal e.m.f.) due to the influence of an AC electrified railroad on a repeater section where the K-24-60 amplifiers are used:

Long Term:

-- When one ZU [protective grounding device] is inserted in the remote power circuit at an NUP and one ZU is inserted at an OUP, and the remote power uses a "wire-ground" circuit configuration	50 volts eff.
-- The same, with the remote power in a "wire-wire" circuit configuration	100 volts eff.
-- When two ZU's are inserted in the remote power circuit at an NUP, and one ZU at an OUP, and the remote power uses a "wire-ground" circuit	300 volts eff.

Short Term:

-- With the remote power in a "wire-ground" circuit	750 volts eff.
-- With the remote power in a "wire-wire" circuit configuration	930 volts eff

The permissible short term voltage (longitudinal e.m.f.) due to the influence of high voltage lines on a repeater section for K-24-60 amplifiers where the remote power uses a:

"wire-ground" circuit configuration	750 volts eff.
"wire-wire" circuit configuration	930 volts eff.

The permissible voltage (longitudinal e.m.f.) due to the influence of electrified railroads using alternating current on a repeater section for K-24p-2m amplifiers:

Long term	75 volts eff.
Short term	250 volts eff.

The permissible short term voltage (longitudinal e.m.f.) due to the influence of high voltage lines on a repeater section for K-24p-2m amplifiers	250 volts eff.

Grounding Devices:

-- For K-24-60 NUP's when powered using a:

"wire-ground" circuit configuration	Two grounds: a working & a protective one
"Wire-wire" circuit configuration	One ground: working (or protective).

-- For the K-24p-2m NUP's when powered using a:

"Wire-ground" circuit configuration:	
NUP within the remote power section	One ground
NUP at the end or the remote power section	Two grounds: working and protective.
"Wire-wire" circuit configuration	One ground.

-- For terminal stations and attended repeaters	Three grounds: a working one and two metering grounds.

Notes: 1. The resistance of each ground should be in accordance with GOST 464-68.

2. The ground is made in accordance with the "Rekomendatsii po voprosam oborudovaniya zazemleniy i zazemlyayushchikh provodov LATs i NUP" ["Recommendations on Questions of Grounding Equipment and Grounding Conductors of Line Equipment Shops and Unattended Repeaters"] ("Svyaz'" Publishers, 1969).

Climatic Operational Conditions

Attended Stations (OP, OUP). At temperatures of from +10 to +40° C, and a humidity of 75%; short term, 80% at a temperatures of +25° C.

Unattended Stations for NUP's with K-24-60 Amplifiers. At temperatures of from 0 to +35° C and a humidity of 75%; short term, 80% at +25° C.

NUP's with K-24p-2m Amplifiers. At temperatures of from -5 to +25° C and a humidity of 75%; short term, 95% at 20° C.

The Electrical Power Supply:

Voltages:

-- Terminal and attended intermediate stations (OP's and OUP's):

Plate	206 v ± 3%
Filament	21.2 v ± 3%
Signaling	24 v ± 10%
AC mains	220 v + 5%, -15%, 48 to 51 Hz

-- Unattended repeater stations (NUP's):

Remote power, fed into the line (max)	450 volts
At the terminals of the equipment being powered, for the following amplifiers:	
K-24-60	145 v ± 10%
K-24p-2m	35 v ± 10%

Current and Power Consumption

Equipment	21.2 v amps	24 v amps	206 v & remote power, amps	220 volts VA
SGU for one system	1.6	-	0.13	-
Signaling	-	0.3	-	-
SGU for two systems	3.2	-	0.26	-
Signaling	-	0.6	-	-
SGNK, main circuits, main power	4.5	-	0.55	-
The same, standby power	4.5	-	0.45	-
Signaling	-	3.0	-	-
Oscilloscope	-	-	-	12.6

Current and Power Consumption, [continued]

Equipment	21.2 v amps	24 v amps	206 v & remote pwr amps	220 volts VA
TM-OUP	-	3.0	-	-
TM-NUP (remote power circuit)	-	-	0.068 (at 24 volts)	-
SPU-1 for one system (main circuit)	1.1	-	0.08	-
Signaling	-	0.2	-	-
SPU-2 for one system (main circuit)	1.4	-	0.13	-
Signaling	-	0.4	-	-
SPU-3 for one system (main circuit)	1.75	-	0.16	-
Signaling	-	0.6	-	-
SPU-N-U-1 for one system (remote power)	-	-	0.225 (145 v)	-
SPU-N-U-2 for two systems (remote power)	-	-	0.275 (145 v)	-
NUP K-24p-2m for one system with incomplete multiplexing of the cable on each remote power circuit	-	-	0.065	-
The same, for one system, with complete multiplexing of the cable on each remote power circuit	-	-	0.095	-

NOTE: The SGNK is being replaced by the SUGO-1-3 equipment (see Section 6).

Equipment Complement:

Terminal Station:

a) Cable Input Equipment:

-- The following are used for links employing the K-24-60 amplifiers in the NUP's: VKS 4 x 4 OUP or VKS 7 x 4 OUP for connecting the high level cables: a rack for two cables; VKS-1 4 x 4 OUP or VKS-1 7 x 4 OUP for connecting the low level cables: a rack for two cables;

-- Used for links employing the K-24p-2m amplifiers in the NUP's is the VKS 1 x 4 OP and for connecting the high and low cables, a rack for two single quad MKSB, MKSA or MKPV cables.

Notes: 1. When using the VKS 4 x 4 OUP racks for a single quad cable, the low level cable is connected into the left box, while the high level cable is connected into the right box of the VKS rack.

2. For trunks up to 300 km long, 135:135 line transformers can be installed; for trunks of greater length, 145:135 transformers can be installed.

b) The SIO-24p Individual Conversion Equipment: one rack for 24 channels (see Section 7).

c) The SGU Rack of Group Devices K-24-2: one rack for 1 - 4 systems.

Notes: 1. The SGU is supplied for one system. To bring the equipment complement of the rack up to two, three and four systems, KGU sets are supplied for each system.

2. Supplied on special order are the block of D-64 and K-104 filters, MV [trunk equalizers], IL [phantom lines] for 5 km, and the panel of transformers.

d) The SUGO-1-3 Generator Equipment (used previously was a rack of the SGNK type): one rack for eight systems (see section 6).

e) The SPDPM K-60 Remote Power Transmission Rack (for NUP's with the K-24-60 amplifiers): For 12, 24 and 48 remote power circuits (see Section 10). (The remote power supply panel is for NUP's with K-24p-2m's for two circuits).

f) The UKVSS Standardized Switching and Callup Service Communications Equipment in the complement of the SS-3 or SS-4 rack (SSS-7 or SSS-8, see Section 11).

g) Remote Control Equipment for OUP's (for links using the K-24-60 amplifiers).

h) Remote Monitoring Equipment (for links using the K-24-60 amplifiers): An instrument for all systems.

i) The SKP-1 Primary Group Switching Rack (it is installed at line equipment shops where planned in the future are no less than 10 primary groups): One rack for 50 primary groups (see Section 1).

j) The SKPG Primary Group Monitor Rack: One rack for 25 primary groups (see Section 11).

The Intermediate Attended Repeater Station (OUP)

a) Cable Engrance Equipment:

-- For links using the K-24-60 amplifiers in the NUP's, the following are used:
VKS 4 x 4 OUP or VKS 7 x 4 OUP: a rack for two cables;
VKS-1 4 x 4 OUP or VKS-1 7 x 4 OUP: a rack for two cables;

-- For links using the K-24p-2m amplifiers at the NUP's, a VKS 1 x 4 OUP is used for connecting in the high and low level cables: a rack for four single quad MKSB, MKSA or MKPV cables.

Notes: 1. When using the VKS 4 x 4 OUP racks for 1 x 4 cables, the low level cables are brought into the left box, while the high level cables are brought into the right box of the VKS rack.

2. Used on the VKO board are 145:135 transformers.

b) The Rack of Intermediate Amplifiers with Dual Frequency AGC, SPU-2 K-24-2: A rack for 1 - 8 systems.

c) The same, with three-frequency AGC, SPU-3 K-24-2: A rack for 1 - 6 systems.

Notes: 1. The SPU-2 and SPU-3 racks are supplied for one system. To fill out the equipment complement, the KPU-2 or KPU-3 sets are supplied for one system;

2. Supplied on special order are the MV [trunk equalizers], IL [phantom lines], and panel of transformers for powering the amplifiers from the AC mains;

3. The SPU-1 racks are not being produced.

d) The Remote Power Transmission Rack

-- For coupling to the K-24-60 amplifiers: the SPDPM K-60 (as for the terminal station), is a rack for 12, 24 or 48 remote power circuits for 4 x 4 cable, and two racks: one for 12 and the second for 48 remote power circuits, for 7 x 4 cable;

-- For coupling to the K-24p-2m amplifiers in the NUP's: the SEP (electrical power supply rack) is a rack for four remote power outputs of 0.15 amps each (from each working PPU).

e) The standardized switching-callup service communications equipment, UKVSS (as also for the terminal station): the SS-3 or SS-4 (or SSS-7 or SSS-8) rack.

f) The remote control equipment (just as for the terminal station) for coupling to the K-24-60 amplifier.

g) The remote monitoring equipment (for coupling to the K-24-60 amplifier: an instrument for all systems.

The Unattended Intermediate Repeater Station (NUP)

NUP's with K-24-60 Amplifiers:

a) Cable Entrance Equipment

-- VKS 4 x 4 NUP or VKS 7 x 4 NUP for connecting the high level cables: a rack for two cables;

-- VKS-1 4 x 4 NUP or VKS-1 7 x 4 NUP for connecting in the low level cables: a rack for two cables;

-- The unattended intermediate, standardized, repeater rack, SPUN K-24-60, is a rack for one to four systems.

Notes: 1. The SPUN K-24-60 is supplied in the following equipment complement: SPU-N-U-4, for four systems; SPU-N-U-2, a rack for two systems; SPU-N-U-1, for one system; KPU-N-U-2, a set for two systems; KPU-N-U-1, a set for one system; and KLU-N-U, a set of amplifiers for one system.

2. Additionally supplied on special order are: fixed trunk equalizer; variable trunk equalizer; block of thermistors (ground referenced AGC) and a panel of power supply filters.

b) The Service Communications Panel, NUP (PVU-NUP): a panel installed in a VKS.

c) Remote Control Board;

d) Remote Monitor Unit: a panel for eight systems, installed in a VKS. The NUP with the K-24p-2m amplifiers is for one to two systems.

Notes: 1. Included in the equipment complement of the NUP K-24p-2m station are: the NUP chassis with the cable entrance unit; four input modules and amplifier modules.

2. For completing the equipment complement of the second system, two small amplifier modules are employed.

Construction:

Attended Station:

SGU. Rack filled on both sides. Rack dimensions are 2,500 x 648 x 464 mm.

SGNK. Rack filled on both sides. Rack dimensions are 2,500 x 647 x 464 mm.

SPU-2, SPU-3. Rack filled on both sides. The rack dimensions are 2,500 x x 648 x 430 mm.

Unattended Station:

SPUN-K-24-60. Rack filled on one side. The rack dimensions are 2,500 x x 644 x 247 mm.

NUP K-24p-2m. See Figure 4.4.17.

Weight and Cost

Equipment	Weight, kg	Price, rubles
SGU K-24-2 for one system	200	1,152
KGU K-24-2 for completing the equipment complement of the SGU	80	987
SGNK	290	2,275
SPU-2 for one system	170	987
KPU-2 for completing the equipment complement of the SPU-2	65	868
SPU-3 for one system	200	1,215
KPU-3 for completing the equipment complement of the SPU-3	80	1,092
SPU-N-4	370	3,522
SPU-N-2	185	1,756
SPU-N-1	120	1,296
KPU-N-2	185	1,756
SPU-N-U-1	120	987
SPU-N-U-2	150	1,288
SPU-N-U-4	300	2,468
KPU-N-U-1	120	987
KPU-N-U-2	150	1,288
KLU-N-U	30	336
NUP-K-24p-2m station for two systems	200	1,583
EK-NUP K-24p-2m operational set	90	1,320

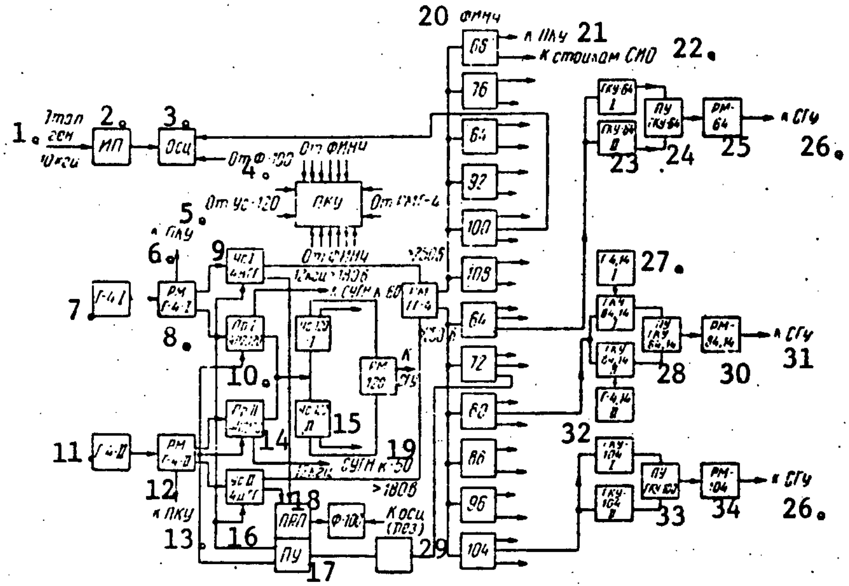


Figure 4.4.1. Block diagram of the carrier and control frequency generator rack, SGNK.

Key: 1. 10 KHz calibration oscillator;
2. IP [expansion unknown];
3. Oscilloscope;
4. From the F-100 [?100 KHz filter?];
5. From the Us-120 [120 KHz amp];
6. To the PKU [control unit panel];
7. G-4-I [4 KHz generator I];
8. RM G-4-I [4 KHz generator I power distributor];
9. Us I i GG [4 KHz amplifier and harmonic generator];
10. Pr I 4/12, 120 [?4/12, 120 KHz converter 1];
11. G-4-II;
12. RM, G-4-II [4 KHz generator 2 power distributor];
13. To the PKU [control unit panel];
14. Pr. II, 4/12, 120;
15. Us-120 II [120 KHz amplifier II];
16. Us II 4 i GG [4 KHz amplifier II and harmonic generator];
17. PU [switching unit];
18. PRP [manual switching panel];
19. SUGN K-60;
20. FINCh [individual carrier frequency filters];
21. To the PKU;
22. To the SIO [individual equipment rack];
23. GKU-64 II [expansion unknown];
24. PU GKU-64;
25. RM-64 [64 KHz power distributor];
26. To the SGU [group equipment rack];
27. G-4, 14 I [4, 14 KHz generator 1];
28. PU GKU 84,14 [unknown];
29. To the oscilloscope (standby);
30. RM 84, 14 [84.14 KHz power distributor];
31. To the rack of group devices;
32. GKU-104-I;
33. PU, GKU-100;
34. RM-104.

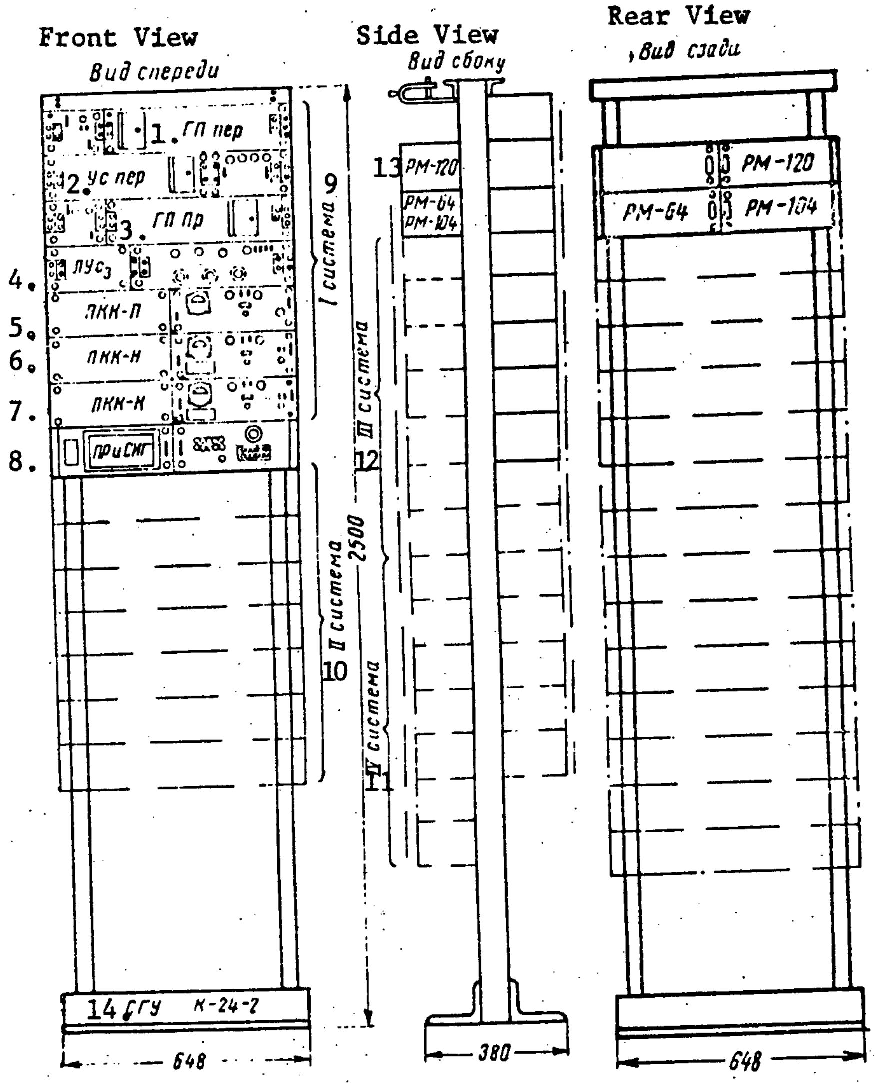


Figure 4.4.2. The placement of the equipment in the rack of group devices, SGU-BK, of the K-24-2 equipment.

Key:
1. GP Per [transmit group converter];
2. Transmit amplifier;
3. Receive group converter;
4. Line amplifier 3;
5. Flat type control channel receiver;
6. Slope type control channel receiver;
7. Curvilinear type control channel receiver;
8. Fuse and signaling panel;
9. System 1;
10. System 2;
11. System 4;
12. System 3.
13. RM-120 [120 KHz power distributor];
14. SGU-K-24-2.

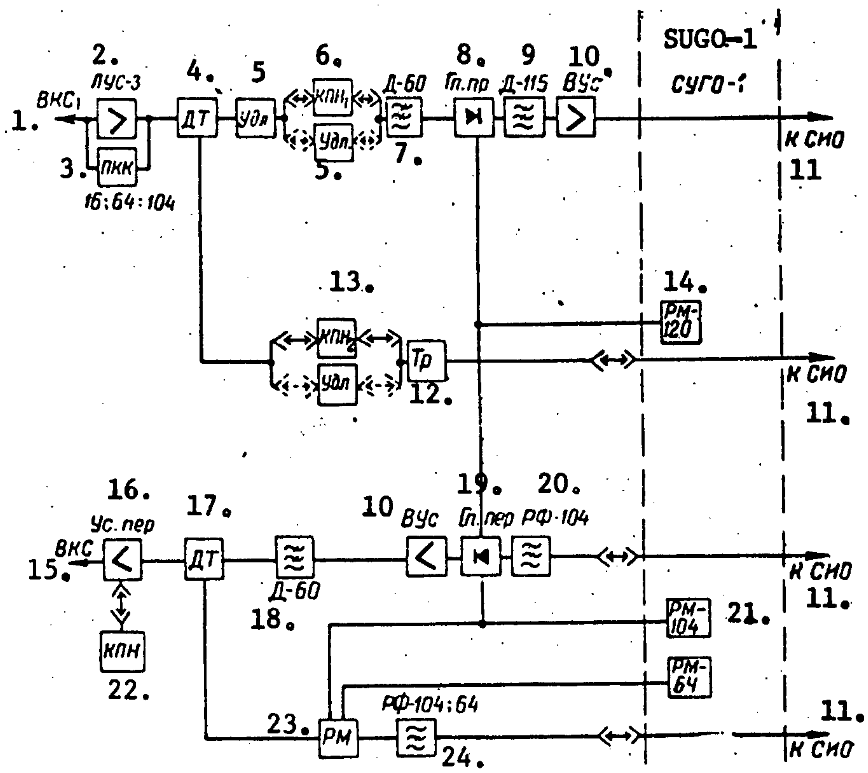


Figure 4.4.3. Block diagram of the SGU rack of group devices of the K-24-2 equipment.

Key:
1. VKS_1 [cable entrance rack 1];
2. Line amplifier 3;
3. Control channel receiver, 16, 64; 104 KHz;
4. Differential transformer;
5. Pad;
6. KPN_1 [either a variable or a constant slope network];
7. D-60 filter;
8. Group converter;
9. D-115 filter;
10. VUs [?auxiliary amplifier?];
11. To the SIO [individual conversion equipment rack];
12. Transformer;
13. KPN_2;
14. RM-120 [120 KHz power distributor];
15. VKS;
16. Transmit amplifier;
17. Differential transformer;
18. D-60 filter;
19. Gp per [?transmit group converter?];
20. RF-104 [104 KHz rejection filter];
21. RM-104 [104 KHz power distributor];
22. KPN;
23. RM [power distributor];
24. RF-104; 64;

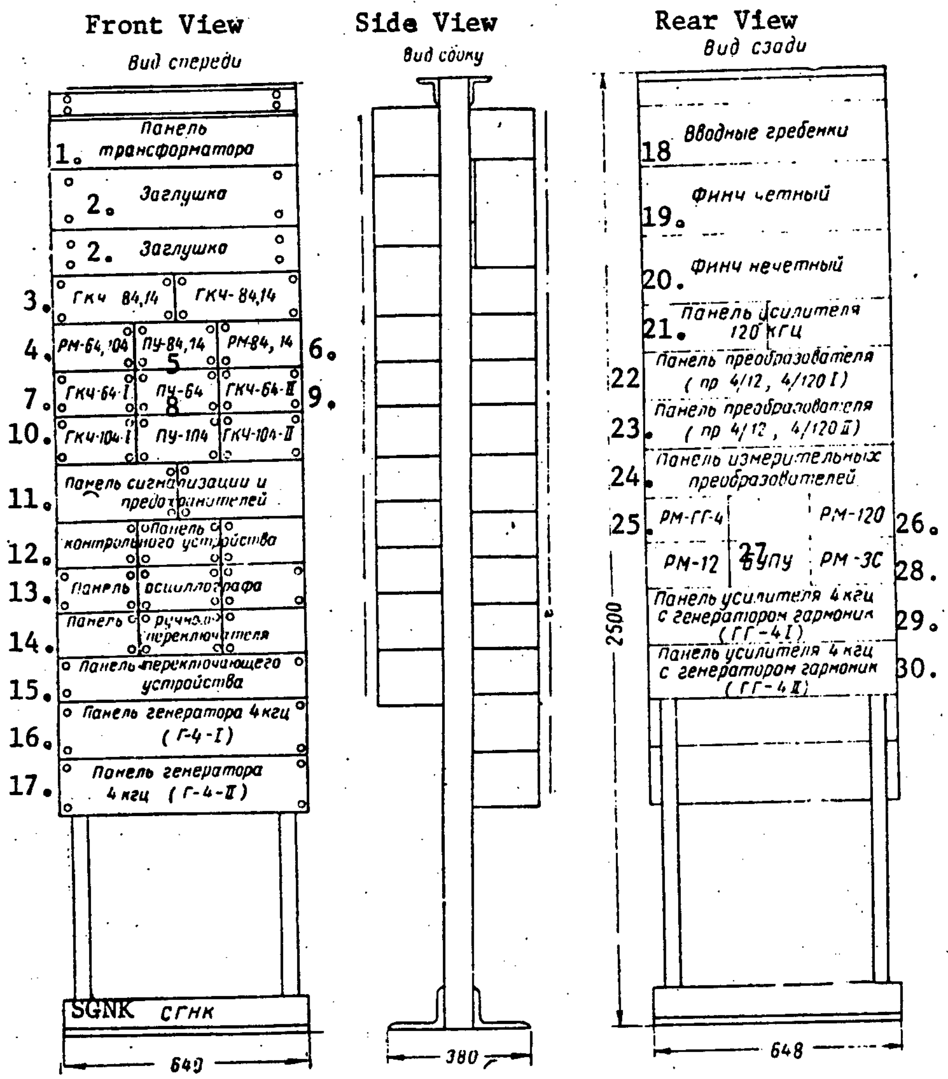


Figure 4.4.4. The placement of the equipment in the carrier and control frequency generator rack, the SGNK.

Key: 1. Transformer panel;
2. Blank panel;
3. GKCh 84, 14 [84 and 14 KHz control frequency generator];
4. RM-64, 104 [64, 104 KHz power distributor];
5. PU-84, 14 [84, 14 KHz switcher];
6. RM-84, 14 [84, 14 KHz power distributor];
7. GKCh-64-I [64 KHz control frequency generator I];
8. PU-64 [64 KHz switcher];
9. 64 KHz control frequency generator II;
10. GKCh-104-I;
11. Signaling and fuse panel;
12. Control unit panel;
13. Oscilloscope panel;
14. Manual switching panel;
15. Switcher panel;
16. 4 KHz generator panel (G-4-I);
17. 4 KHz generator panel (G-4-II);
18. Input terminal blocks;

[Key to Figure 4.4.4, continued]:

19. Even individual carrier frequency filters;
20. Odd individual carrier frequency filters;
21. 120 KHz amplifier panel;
22. Converter panel (pr 4/12, 4/120 I);
23. Converter panel (pr 4/12, 4/120 II);
24. Panel of meter converters;
25. RM-GG-4 [4 KHz harmonic generator power distribution panel];
26. RM-120 [120 KHz power distribution panel];
27. BUPU [expansion unknown];
28. RM-3S;
29. 4 KHz amplifier with harmonic generator panel (GG-4 I);
30. 4 KHz amplifier with harmonic generator panel (GG-4 II).

[Key to Figure 4.4.5, page 267]:

1. Line amplifier 1;
2. PKK-P [flat type control channel receiver];
3. Fuses and signaling.

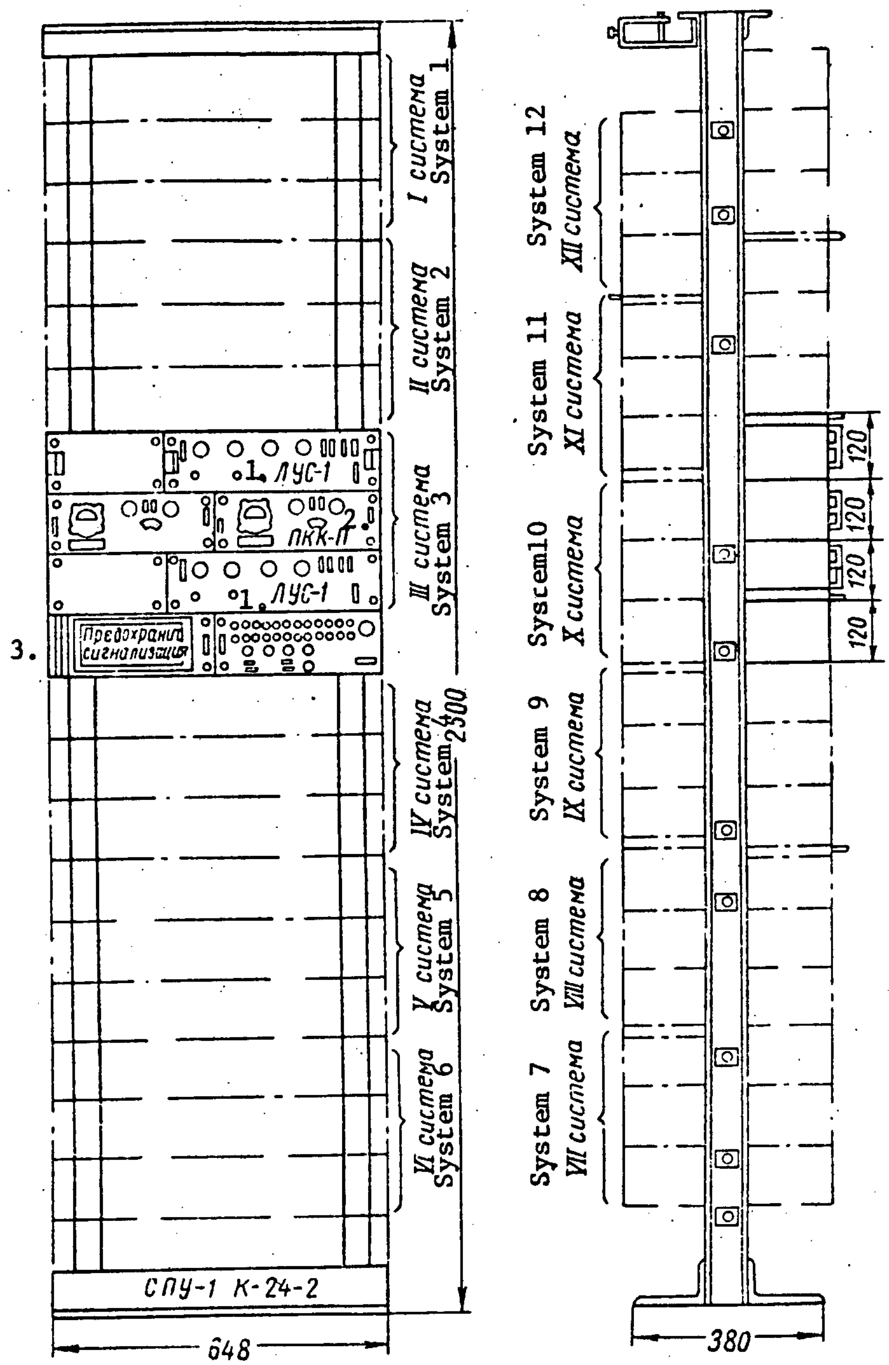


Figure 4.4.5. The placement of the equipment in the STU-1 intermediate amplifier rack of the K-24-2 equipment.

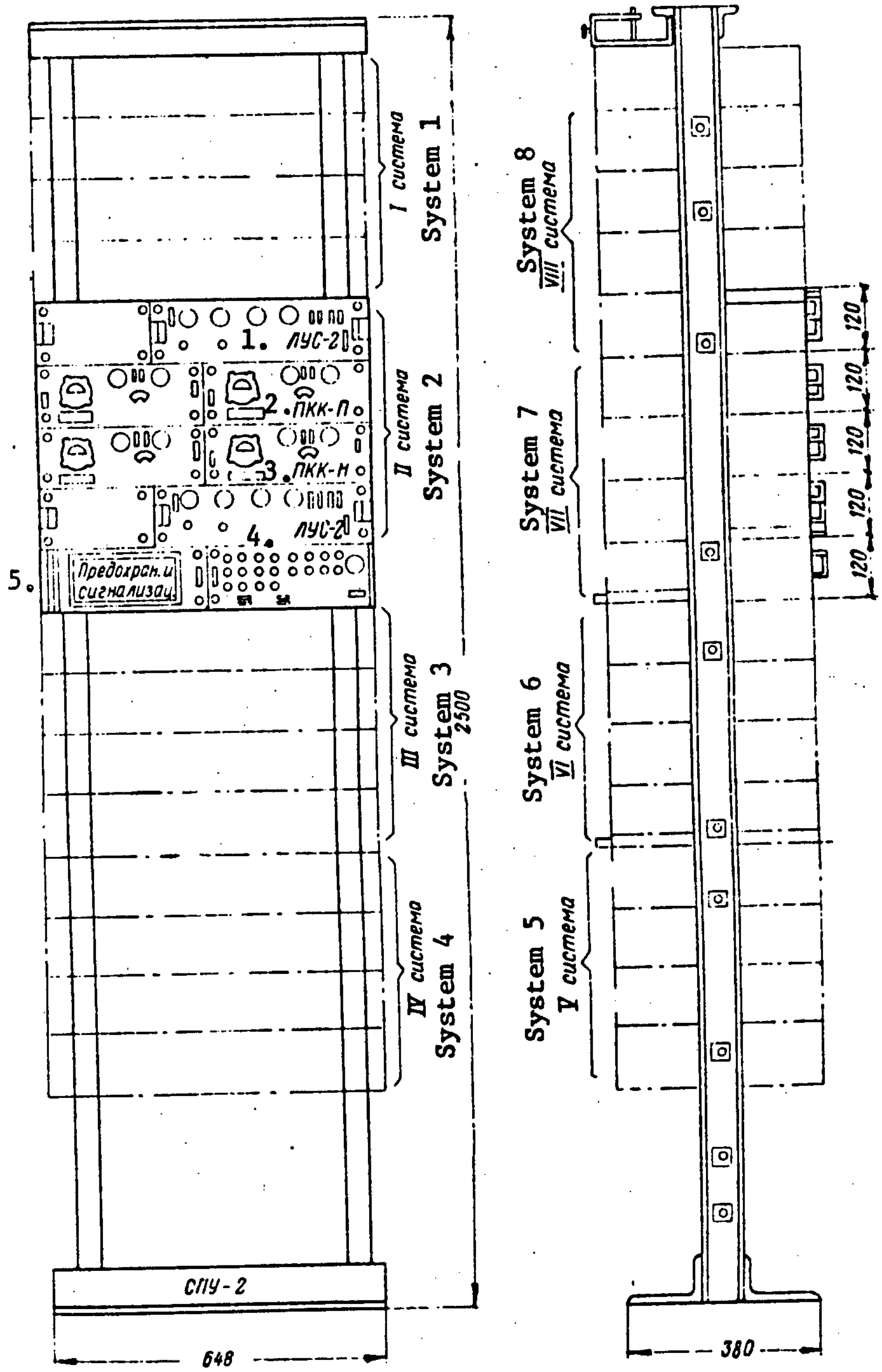


Figure 4.4.6. The placment of the equipment in the SPU-2 intermediate amplifier rack of the K-24-2 equipment.

Key: 1. Line amplifier 2;
2. PKK-P [flat type control channel receiver];
3. PKK-N [slope type control channel receiver];
4. LUS-2 [line amplifier 2];
5. Fuses and signaling.

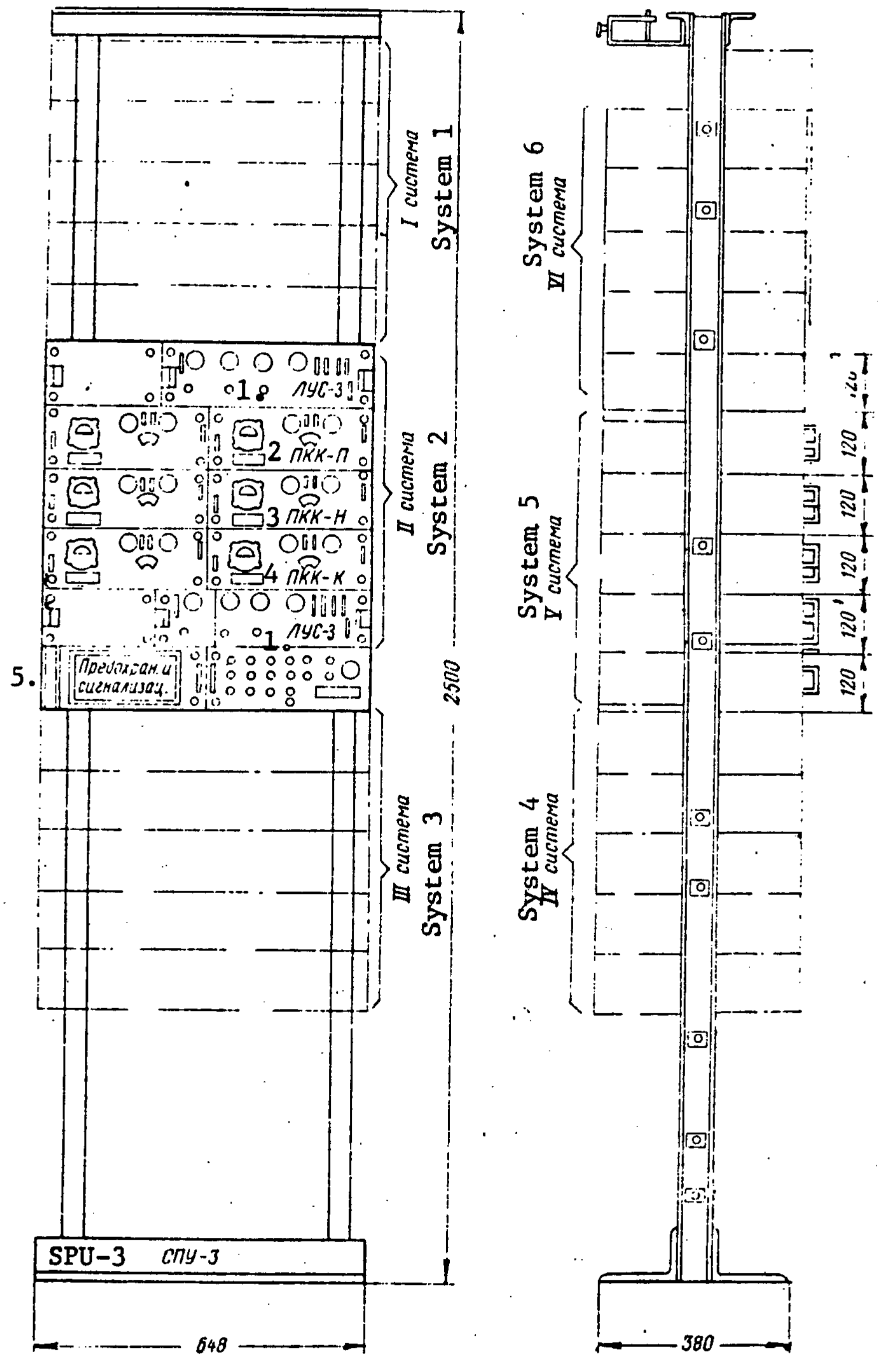


Figure 4.4.7. The placement of the equipment in the SPU-3 intermediate amplifier rack of the K-24-2 equipment.

Key: 1. Line amplifier 3;
2. Flat type control channel receiver;
3. Slope type control channel receiver;
4. Curvilinear type control channel receiver;
5. Fuses and signaling.

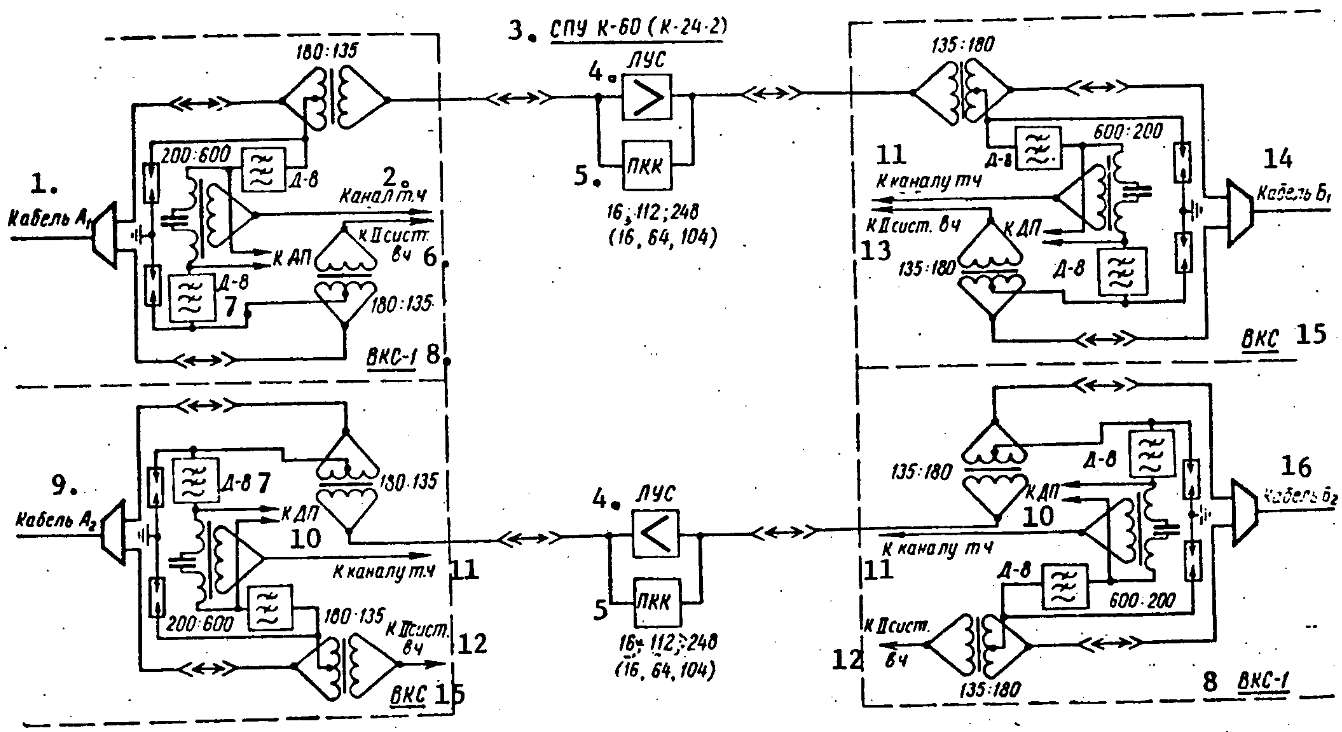


Figure 4.4.8. Block diagram of the through passage of cable pairs, multiplexed with the K-60 or K-24-2 transmission system in the line equipment shop of an attended repeater station. (Indicated in parentheses are the control frequencies for the K-24-2 systems).

Key:
1. Cable A1;
2. Voice frequency channel;
3. SPU K-60 (K-24-2);
4. Line amplifier;
5. Control channel receiver;
6. To Hf system II;
7. D-8 filter;
8. VKS-1 [cable entrance rack 1];
9. Cable A2;
10. To the remote power supply;
11. To the voice frequency channel;
12. To HF system II;
13. To HF system II;
14. Cable B1;
15. VKS;
16. Cable B2.

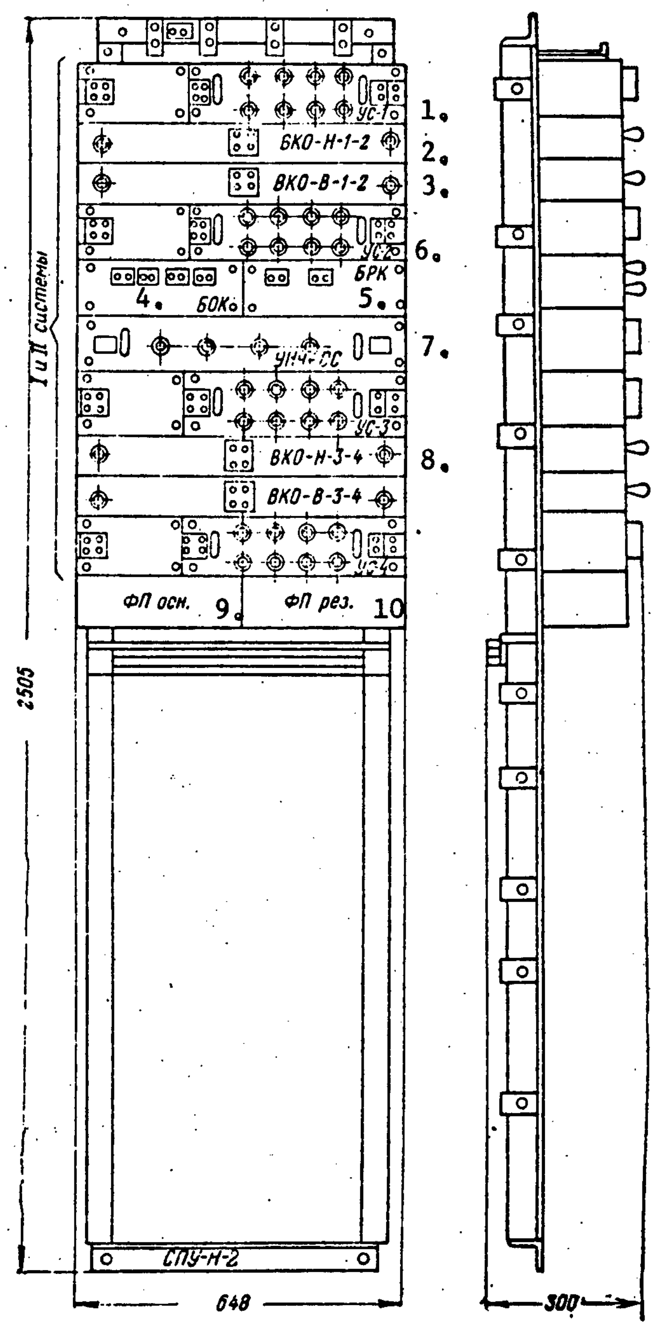


Figure 4.4.9. The placement of the equipment in the SPU-N-2 intermediate amplifier rack of the K-24-2 equipment for two systems.

Key: 1. US-1 [amplifier 1];
2. VKO-N-1-2 [low level cable entrance unit?];
3. VKO-V-1-2 [high level cable entrance unit?];
4. BOK [?channel combining block?];
5. BRK [?channel separation block?];
6. Amplifier 2;
7. Low frequency service communications amplifier;
8. VKO-N-3-4;
9. FP osn. [unknown type of main filter unit];

[Key for Figure 4.4.9, continued]: 10. FP rez [unknown type of backup filter unit].

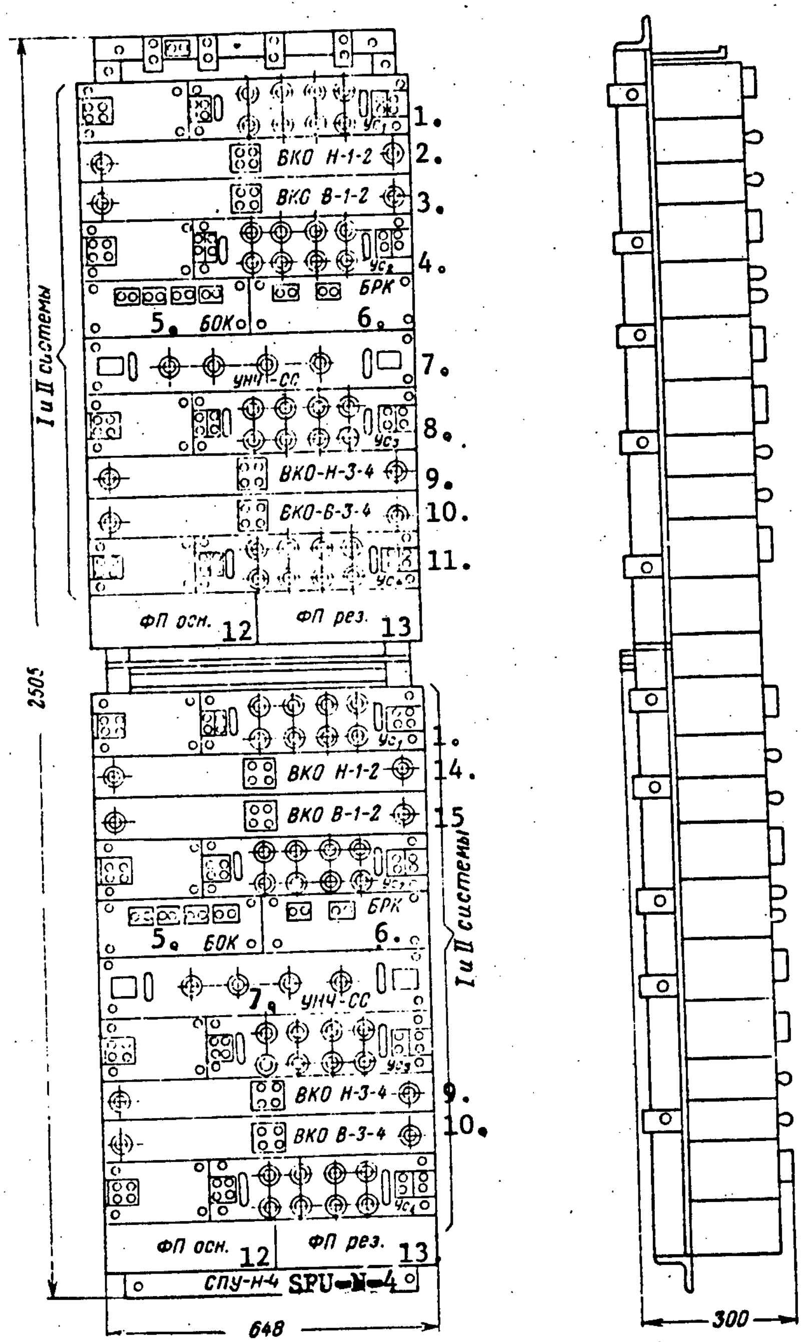


Figure 4.4.10. The placement of the equipment in the SPU-N-4 unattended intermediate amplifier rack of the K-24-2 equipment for four systems.

Key: 1. Amplifier 1;
2. VKO-N-1-2 [?low level cable input unit?];

[Key to Figure 4.4.10, continued]:

3. VKO-V-1-2 [?high level cable input unit?];
4. Amplifier 2;
5. BOK [?channel combining block?];
6. BRK [?channel separation block?];
7. UNCh-SS [low frequency, service communications amplifier];
8. Amplifier 3;
9. VKO-N-3-4;
10. VKO-V-3-4;
11. Amplifier 4;
12. FP osn [unknown type of main filter unit];
13. FP rez [unknown type of backup filter unit];
14. VKO-N-1-2 [low level cable input unit?];
15. VKO-V-1-2.

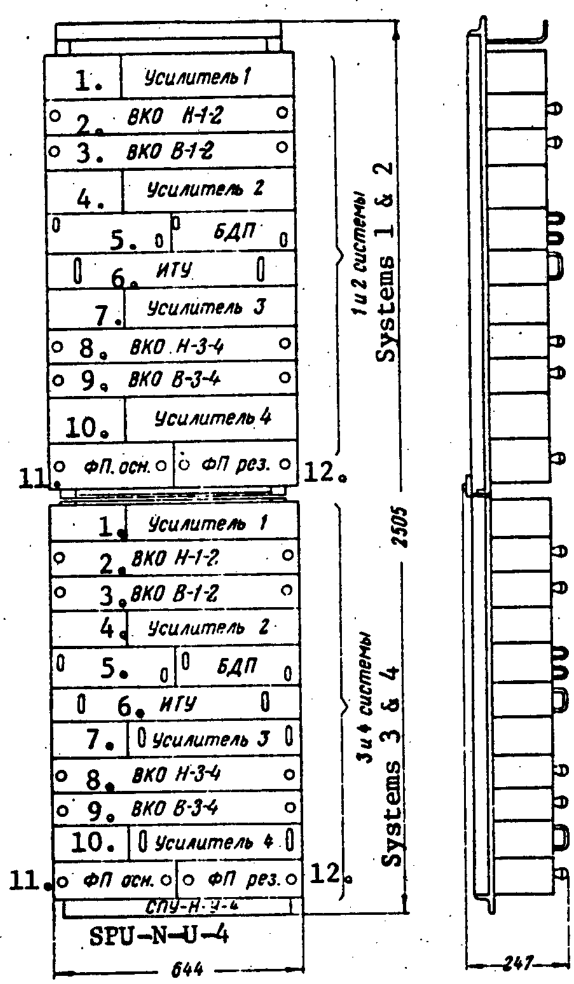


Figure 4.4.11. The placement of the equipment in the SPU-N-U-4 standardized, unattended, intermediate amplifier rack for four systems of the K-24 or K-260 equipment.

[Key to Figure 4.4.11]:

1. Amplifier 1;
2. VKO N-1-2 [?low level cable input equipment?];
3. VKO V-1-2 [?high level cable input equipment?];
4. Amplifier 2;
5. BDP [?remote power supply block?];
6. ITU [?metering and remote control unit?];
7. Amplifier 3;
8. VKO N-3-4;
9. VKO V-3-4;
10. Amplifier 4;
11. FP Osn. [unknown type of main filter unit];
12. FP rez. [unknown type of backup filter unit].

[Key to Figure 4.4.12]:

1. Amplifier 1;
2. VKO-N-1-2 [?low level cable input equipment?];
3. VKO-V-1-2 [?high level cable input equipment?];
4. Amplifier 2;
5. BDP [?remote power supply block?];
6. ITU [?metering and remote control unit?];
7. Amplifier 3;
8. VKO-N-3-4;
9. VKO-V-3-4;
10. Amplifier 4;
11. FP osn [unknown type of main filter unit];
12. FP rez. [unknown type of backup filter unit?].

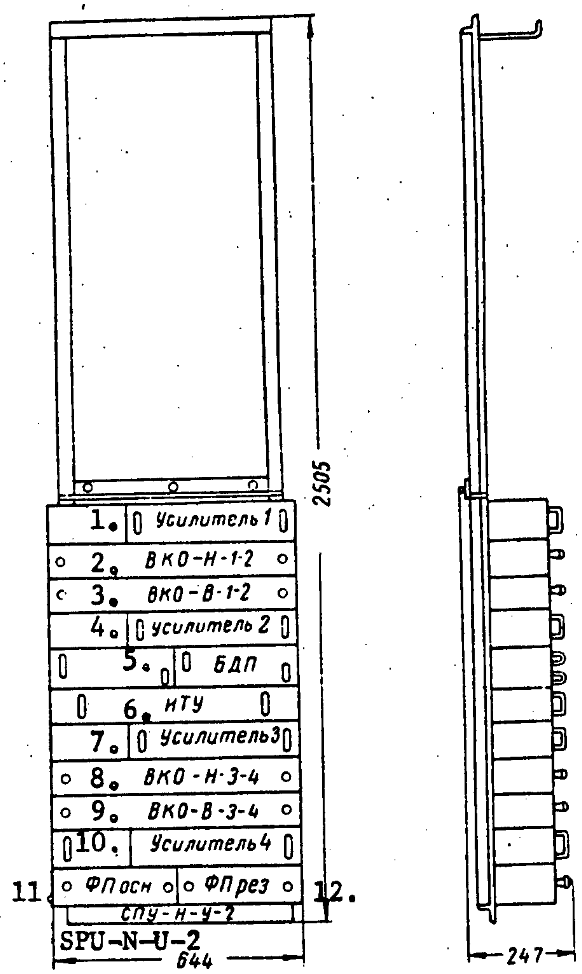


Figure 4.4.12. The placement of the equipment in the standardized, unattended, intermediate amplifier rack for two systems, the SPU-N-U-2, of the K-24 or K-60 equipment.

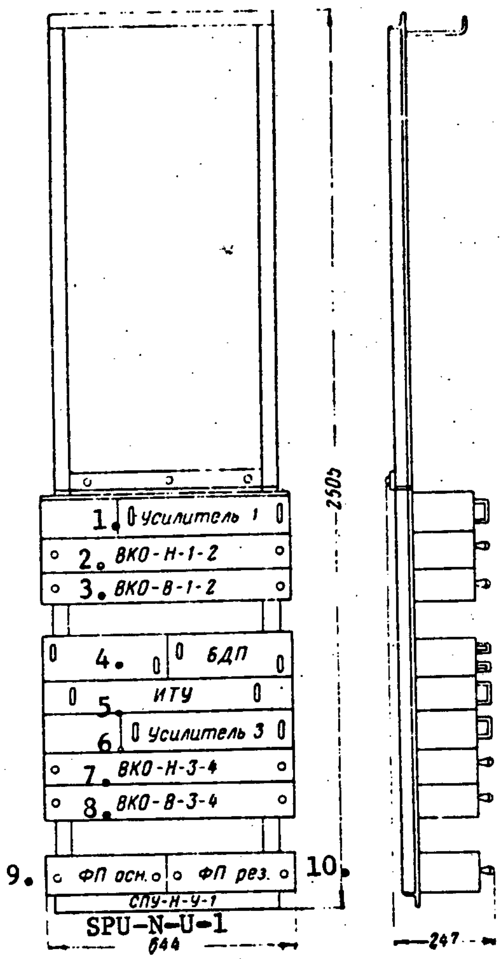


Figure 4.4.13. The placement of the equipment in the standardized, unattended intermediate amplifier rack for one system, the SPU-N-U-1, of the K-24 or K-60 equipment.

Key: 1. Amplifier 1;
2. VKO-N-1-2 [?low level cable input equipment?];
3. VKO-V-1-2 [?high level cable input equipment?];
4. BDP [?remote power supply block?];
5. ITY [?metering and remote control unit?];
6. Amplifier 3;
7. VKO-N-3-4;
8. VKO-V-3-4;
9. FP osn. [unknown type of main filter unit];
10. FP rez. [unknown type of backup filter unit];

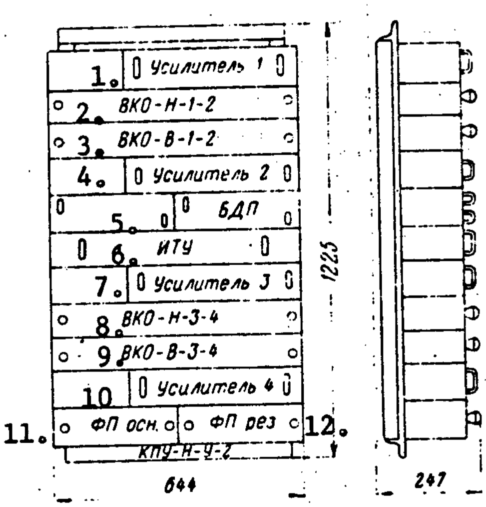


Figure 4.4.14. The placement of the equipment in the set of standardized, unattended intermediate amplifiers for two systems, the KPU-N-U-2, of the K-24 or K-60 equipment.

Key: 1. Amplifier 1;
2. VKO-N-1-2 ;
3. VKO-V-1-2;
4. Amplifier 2;
5. BDP [?remote power supply block?];
6. ITU [?metering and remote control?];
7. Amplifier 3;
8. VKO-N-3-4;
9. VKO-V-3-4;
10. Amplifier 4;
11. FP osn. [unknown type of main filter unit];
12. FP rez. [unknown type of backup filter unit].

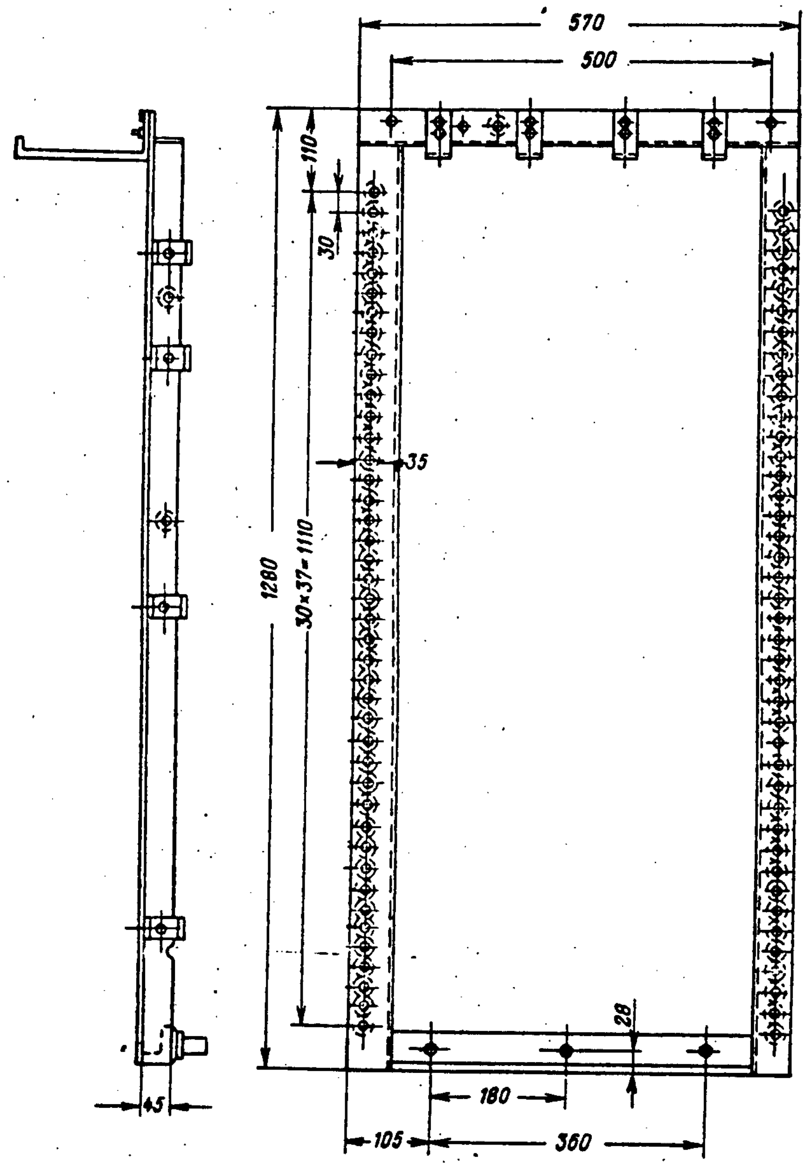


Figure 4.4.15. The rack frame of the SPU-N-U equipment (upper part).

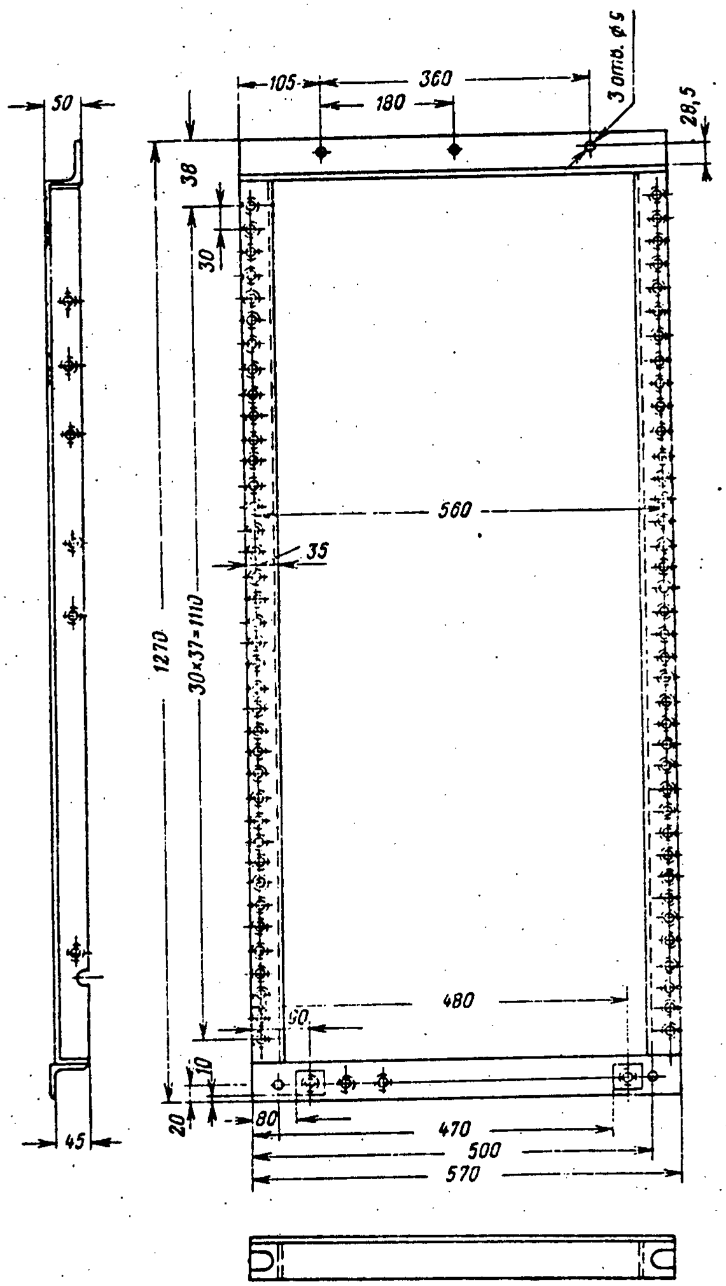


Figure 4.4.16. The rack frame of the SPU-N-U equipment (lower part).

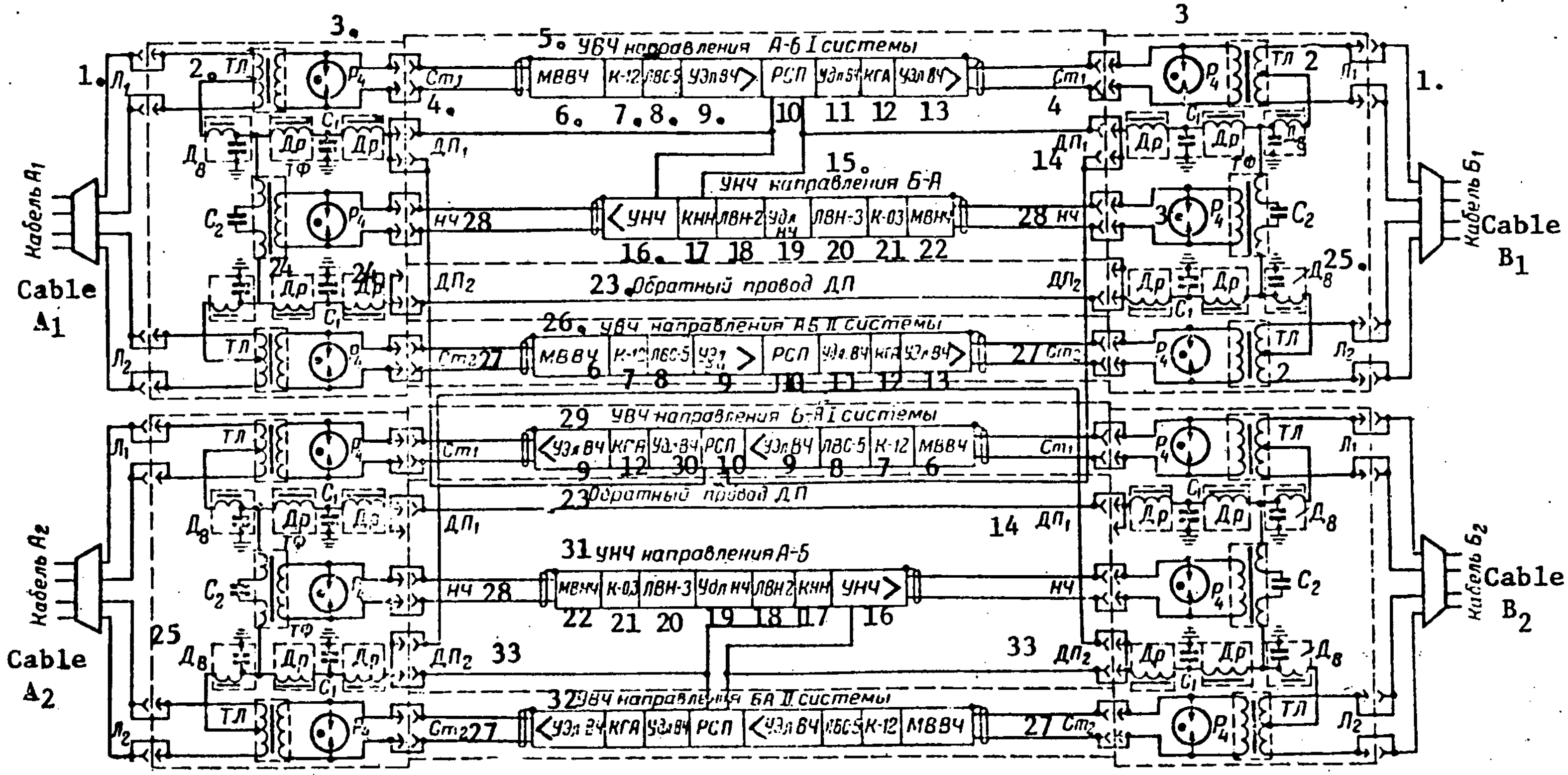


Figure 4.4.17. Block diagram of the unattended repeater station of the K-24p-2m equipment for two systems.

Key:
1. Line 1;
2. Line transformer;
3. R_4 [R4 type discharger];
4. Station 1;
5. High frequency amplifier for direction A-B of system 1;
6. MBBCh [high frequency trunk equalizer];
7. K-12 filter;
8. LVS-5 [expansion unknown];
9. UElVCh [high frequency amplifier element];
10. RSP [expansion unknown];
11. High frequency pad;
12. KGA [expansion unknown];
13. High frequency amplifier element;

[Key to Figure 4.4.17, continued]:

14. DP_1 [remote power circuit 1];
15. Low frequency amplifier for direction B - A;
16. Low frequency amplifier;
17. KNN [initial slope network];
18. LVN-2 [expansion unknown];
19. Low frequency pad;
20. LVN-3;
21. K-03 filter;
22. MVNCh [low freqeuncy trunk equalizer];
23. Return remote power wire;
24. Dr [choke];
25. D_8 [D8 filter];
26. High frequency amplifier for direction A-B of system 2;
27. Station 2;
28. Low frequency;
29. High frequency amplifier for direction B-A of system 1;
30. High frequency pad;
31. Low frequency amplifier for direction A-B;
32. High frequency amplifier for direction B-A of system 2;
33. Remote power circuit.

4.5. The BK-24 24-Channel Transmission System (Manufactured in the Hungarian People's Republic)

Figures 4.5.1 - 4.5.5.

Purpose:

Intended for multiplexing balanced cables (noncoil-loaded). In terms of electrical characteristics, the BK-24 terminal station is similar to the K-24-2 domestic equipment, and can operate with the K-24-2 or K-24-60 intermediate amplifiers.

The main distinction of the SIO [individual conversion equipment rack] of the BK-24 equipment from the SIO of the K-24-2 equipment consists in the following: The conversion of the standard 12-channel block (60 - 108 KHz) is accomplished in two modulation stages: in the first stage, four preliminary groups are formed from each three channels, and go in a passband of 12 - 24 KHz (carrier frequencies of 12, 16 and 20 KHz); in the second stage, the four preliminary groups are converted to the 60 - 108 KHz spectrum (the carrier frequencies are 84, 96, 108 and 120 KHz).

Type of Line: MKB or MKSB 4 x 4 or 7 x 4 cable with a core diameter of 1.2 mm.

Communications System: Two-cable, single-band.

Electrical Characteristics:

Line spectrum	12 - 108 KHz
The effectively transmitted passband	300 - 3,400 Hz

The number of channels which can be organized	24
The capability of secondary multiplexing of the channels	See the introduction
The length of a retransmission section	2,500 km
The maximum communications range	12,500 km
The number of retransmission sections	5
The nominal length of a repeater section of a trunk on an OUP--OUP section where a_{nom} is the nominal attenuation of the repeater section at 108 KHz; α_t is the cable attenuation factor at the maximum groud temperature.	$a_{nom}/\alpha_{t\ max}$

Note: For MKSB cable, the length of a repeater section is 33.2 ± 0.76 km.

The residual attenuation of a channel at 800 Hz	0.8 Np
The nonlinearity attenuation at the highest transmitted frequency (108 KHz) for the case of a transmit level at the amplifier output of 0 nepers with respect to power:	
a_{2h}	9 Np
a_{3h}	12 Np
The input impedance from the connection end:	
Of a two-wire low frequency channel	600 ohms
Of a four-wire channel, input and output	600 ohms
Of the group channel	135 ohms or 150 ohms (variable)
The nominal relative voice frequency level of the four-wire section of a channel:	
At the input	-1.5 Np
At the output	+0.5 Np
The nominal relative transmit level at the output of the terminal and intermediate stations (with respect to power) for each of the channels	+0.2 ± 0.1 Np
The internal noise level, referenced to the amplifier input, in a range of 300 - 3,400 Hz	No more than -15.2 Np
The channel stability over one retransmission section	No less than 0.6 Np
Psophometric noise, measured when two terminal stations are tied in through phantom lines with an attenuation of 7.0 Np at a frequency of 108 Khz at the point with a relative level of +0.5 Np	Does not exceed 0.6 mv without a load on the system, and 0.8 mv when the system is loaded.

The frequency for noise calculation	108 KHz
The immunity to perceptible crosstalk at 800 Hz	8.5 Np for the 4th, 5th and 6th channels, 7.5 Np for the remaining channels.
The AGC system	Electromechanical, two- and three-frequency
Control frequencies	16, 64 and 104 KHz
Group control frequency	84.14 KHz
Voice frequency ringing frequency	2,100 Hz
The reflection factor with respect to the 135 Ohm impedance (SGU) [group equipment rack], from the:	
SIO connection end	No more than 15%
Line	$\Delta p \leq 0.15\sqrt{f_{max}/f}$, and no more than 0.25.
The equalizing network in the negative feedback circuit is designed for a drop in the levels at the edge channels of	1.0 Np
Flat type gain control for the amplifier by varying the level of negative feedback	1.3 ± 0.1 Np in the extreme position of the flat AGC control, for the minimum ground temperature (-2° C), in steps of 0.1 NP each. Inserted at the amplifier input is a potentiometer with an attenuation of 2.4+ + 0.1 Np, adjustable in steps of 0.3 Np.

Climatic Operational Conditions:

At temperatures of from +10 to +35° C (at a humidity of 80%, and a temperature of +20° C for the course of two months per year).

The Electrical Power Supply

Voltages:	Plate	206 volts ± 3%
	Filament	21.2 volts ± 3%
	Signaling	24 volts ± 10%

The SIO [individual conversion equipment rack] is powered from 24 volts ± 10%, or 21.2 volts ± 3%.

Current Consumption

Equipment	21.2 volts amps	24 volts amps	206 volts amps
SIO	-	1.2	-
SIO when ringing units are operating	-	2.7	-
SGU for one system	1.3	0.04-1.0	0.83
SGNK [carrier and control frequency generator rack] (main and standby)	7.6	0.05-1.8	1.2

Equipment Complement

SIO-24. The individual equipment rack. It is intended for the conversion of the 300 - 3,400 Hz voice frequencies to the 60 - 108 KHz spectrum (and back). It is supplied as a set for 12 or 24 channels. Housed in the unit are the following: the voice frequency ringing and dialing equipment, differential systems, bandpass filters, etc. Housed in the rack are the following: fixed frequency generator for 300, 400, 600, 800, 1,000, 1,600, 2,100, 3,000 and 3,400 Hz and a level meter from +2 to -6 Np.

SGU. The rack of group devices. Intended for the conversion of the 60 - 108 KHz spectrum to the 12 - 108 KHz line spectrum and back. It is put together as a set for one, two or three systems. Using the LUs-3 [line amplifier 3], the SGU compensates for the attenuation of the adjacent repeater section of a cable, as well as the temperature variations in the cable attenuation. To fill out the equipment of the SGU, SGU sets are supplied for one system.

SGNK. The carrier and control frequency generator rack. The rack makes it possible to derive: the main 4 KHz frequency, the 12, 16 and 20 KHz individual carrier frequencies, the carrier frequency of the system at 120 KHz, the pre-group carriers of 84, 96, 108 and 120 KHz, as well as the control frequencies of 64, 104 and 84.14 KHz (the control frequencies are fed to the input of the primary group channel). All of the generator equipment assemblies are provided with backups. An oscilloscope and level meter are mounted in the rack.

Note: The service communications, remote power supply, automatic voltage control equipment and cable entrance racks are of domestic manufacture (just as the amplifier equipment of the SPU-N unattended stations).

Construction: The equipment of the system is housed in cabinets with dimensions of 2,600 x 660 x 250 mm.

Weight: 250 kg (each rack).

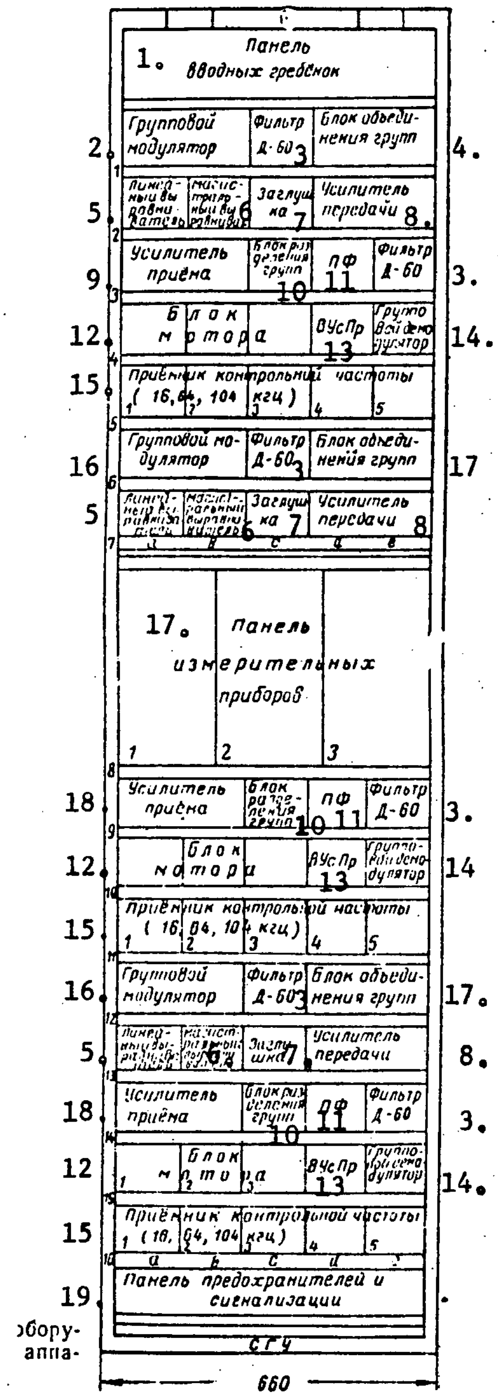


Figure 4.5.1. The placement of the equipment in the SGU rack of the BK-24 equipment.

Key:

1. Panel of input terminal blocks;
2. Group modulator;
3. D-60 filter;
4. Group combining block;
5. Line equalizer;
6. Trunk equalizer;
7. Blank panel;
8. Transmit amplifier;
9. Receive amplifier;
10. Group separation block;
11. PF [bandpass filter];
12. Motor block;
13. VUs Pr [?input receive amplifier?];
14. Group demodulator;
15. Control frequency receiver (16, 64, 104 KHz);
16. Group modulator;
17. Group combining block;
18. Receive amplifier;
19. Fuse and signaling panel.

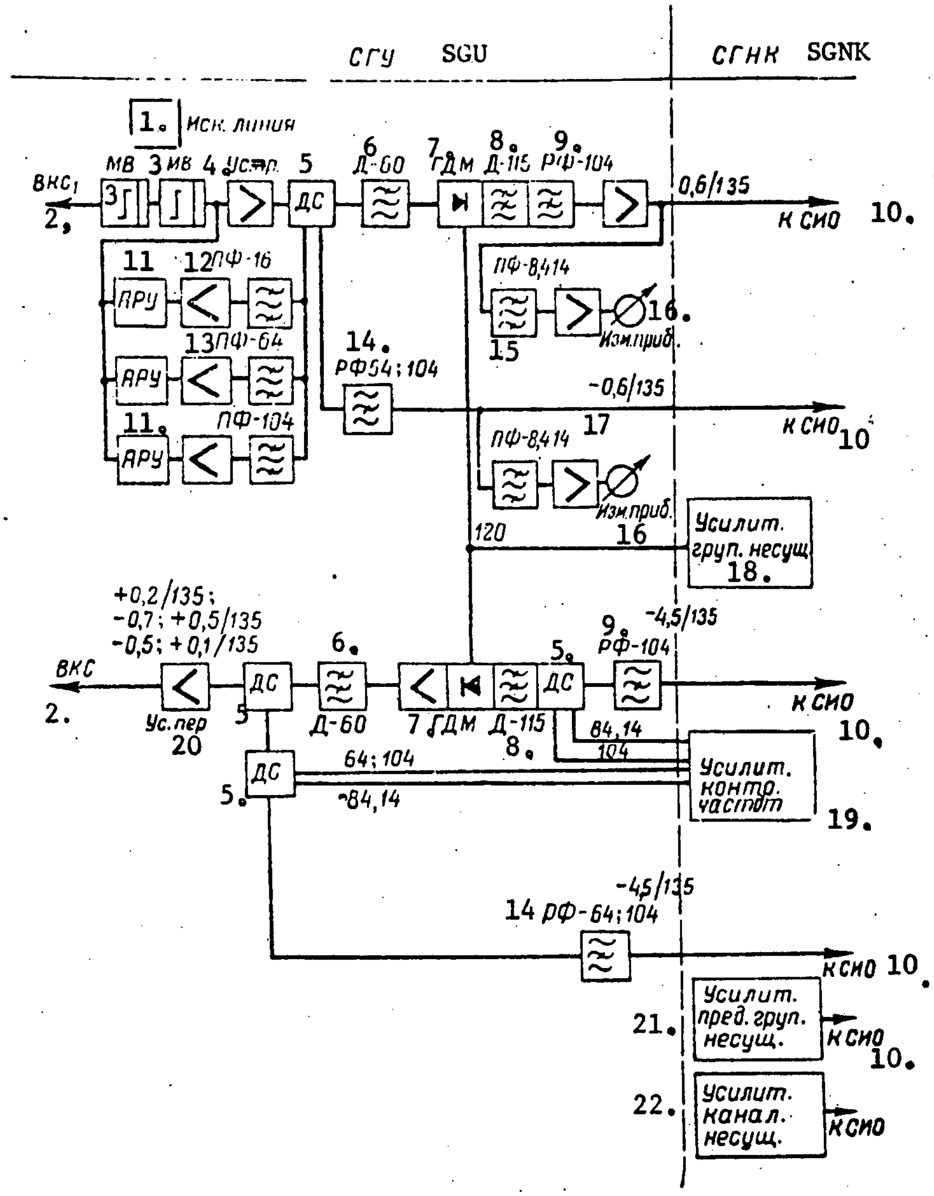


Figure 4.5.2. Block diagram of the rack of group devices, SGU, of the BK-24 equipment.

Key:
1. Phantom line;
2. VKS$_1$ [cable entrance rack 1];
3. MV [trunk equalizer];
4. Receive amplifier;
5. Differential system;
6. D-60 filter;
7. GDM [group demodulator];
8. D-115 filter;
9. RF-104 [104 KHz rejection filter];
10. To the SIO [individual conversion equipment rack];
11. ARU [automatic gain control, AGC];
12. PF-16 [16 KHz bandpass filter];
13. PF-64;
14. RF 64; 104 [64, 104 KHz rejection filter];
15. PF-84,14 [84.14 KHz bandpass filter];

[Key to Figure 4.5.2, continued]:

16. Meter;
17. PF-84,14 [84.14 KHz bandpass filter];
18. Group carrier amplifier;
19. Control frequency amplifier;
20. Transmit amplifier;
21. Preliminary group carrier amplifier;
22. Carrier channel amplifier.

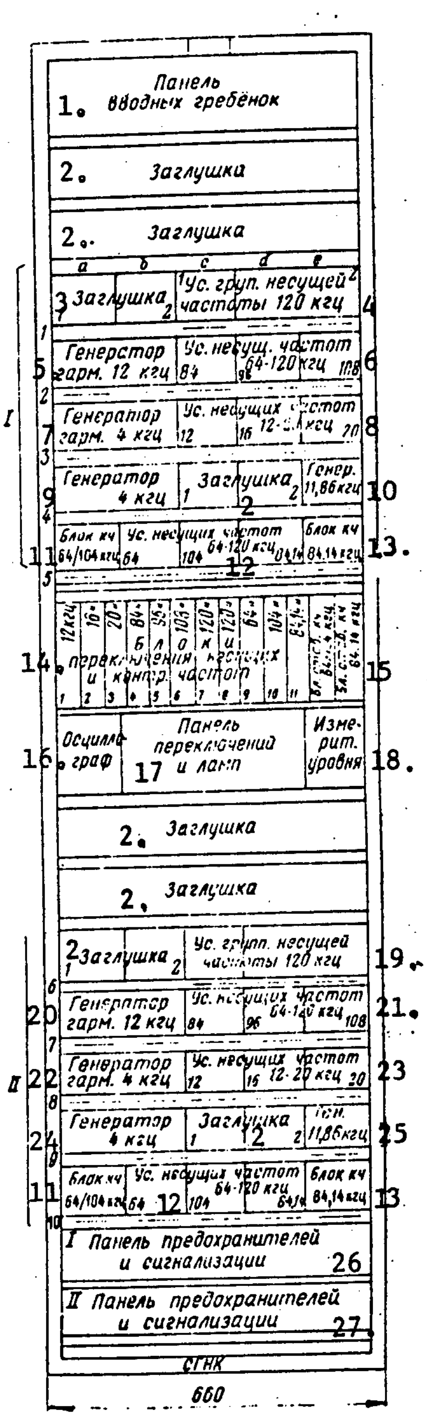


Figure 4.5.3. The placement of the equipment in the SGNK rack [carrier and control frequency generator rack] of the BK-24 equipment.

Key:

1. Panel of input terminal blocks;
2. Blank panel;
3. Blank panel;
4. 120 KHz group carrier frequency amplifier;
5. 12 KHz harmonic generator;
6. 64 - 120 KHz carrier frequency amplifier;
7. 4 KHz harmonic generator;
8. 12 - 20 KHz carrier frequency amplifier;
9. 4 KHz generator;
10. 11.86 KHz generator;
11. 64/104 KHz control frequency block;
12. 64 - 120 KHz carrier frequency amplifier;
13. 84.14 KHz control frequency block;
14. Control frequency and carrier switching blocks;
15. 84.14 KHz control frequency regulator block;
16. Oscilloscope;
17. Switching and light panel;
18. Level meter;
19. 120 KHz group carrier frequency amplifier;
20. 12 KHz harmonic generator;
21. 64 - 120 KHz carrier frequency amplifier;
22. 4 KHz harmonic generator;
23. 12 - 20 KHz carrier frequency amplifier;
24. 4 KHz generator;
25. 11.86 KHz generator;
26. Fuse and signaling panel I;
27. Fuse and signaling panel II.

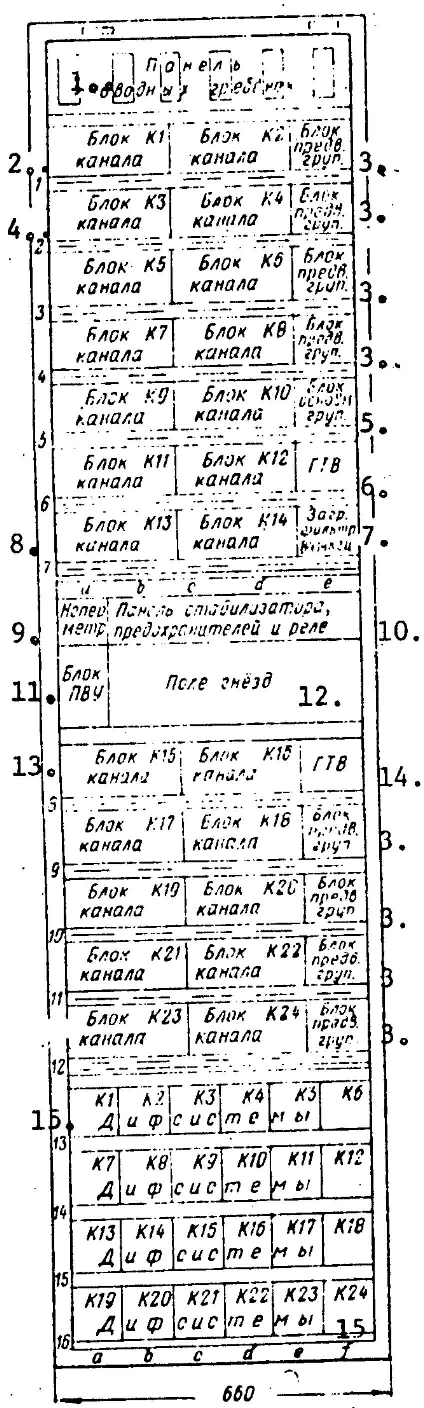


Рис. IV.5.4. Размещение оборудования на стойке СИО аппаратуры БК-24

Figure 4.5.4. The placement of the equipment in the SIO [individual conversion equipment rack] of the BK-24 equipment.

Key:

1. Panel of input terminal blocks;
2. Channel block K1 [channel 1];
3. Preliminary group block;
4. Channel block K3;
5. Main group block;
6. GTV [voice frequency ringing generator];
7. 84.14 KHz suppression filter;
8. Channel block K13;
9. Neper meter;
10. Regulator, fuse and relay panel;
11. Intercom-callup unit block;
12. Jackfield;
13. Channel block K15;
14. Voice frequency ringing generator;
15. Differential system.

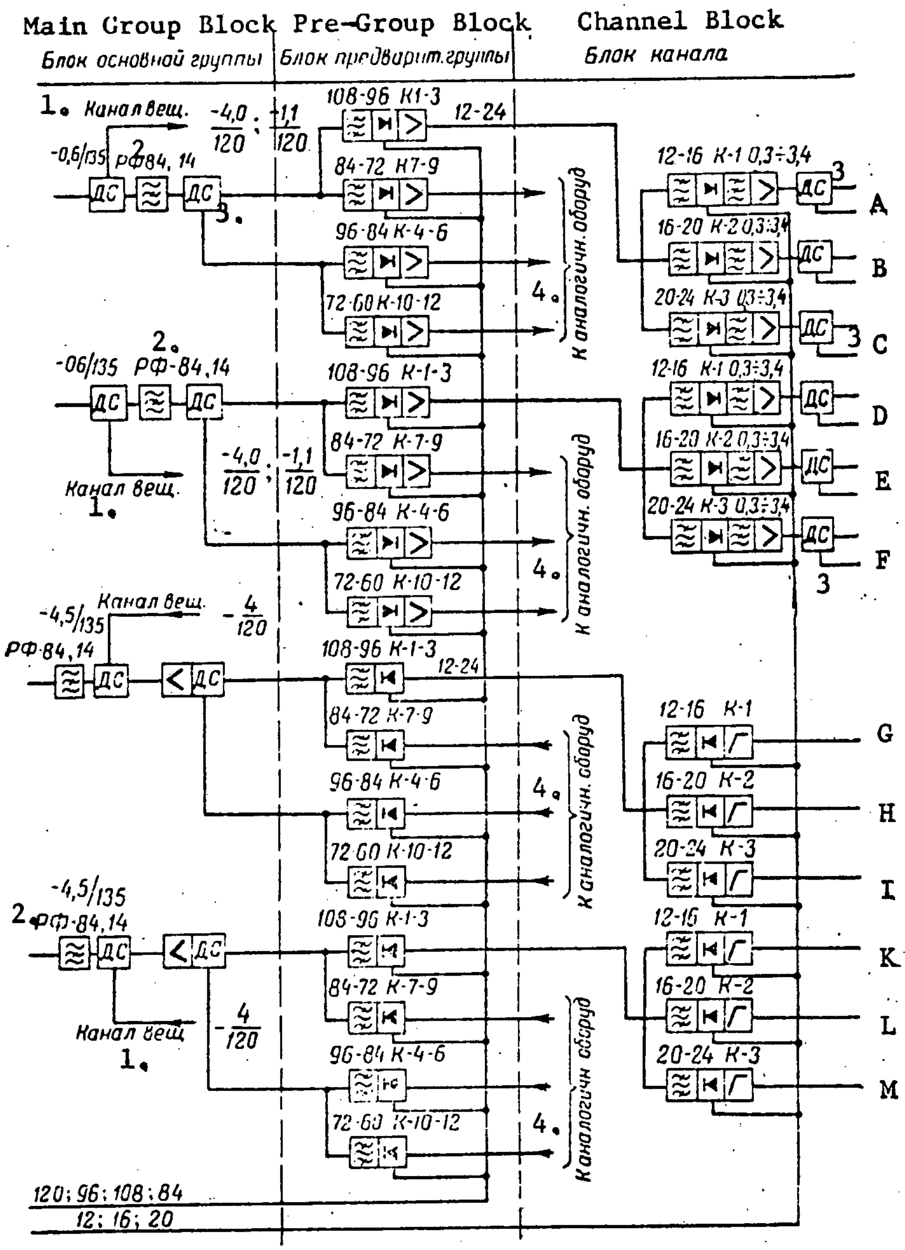
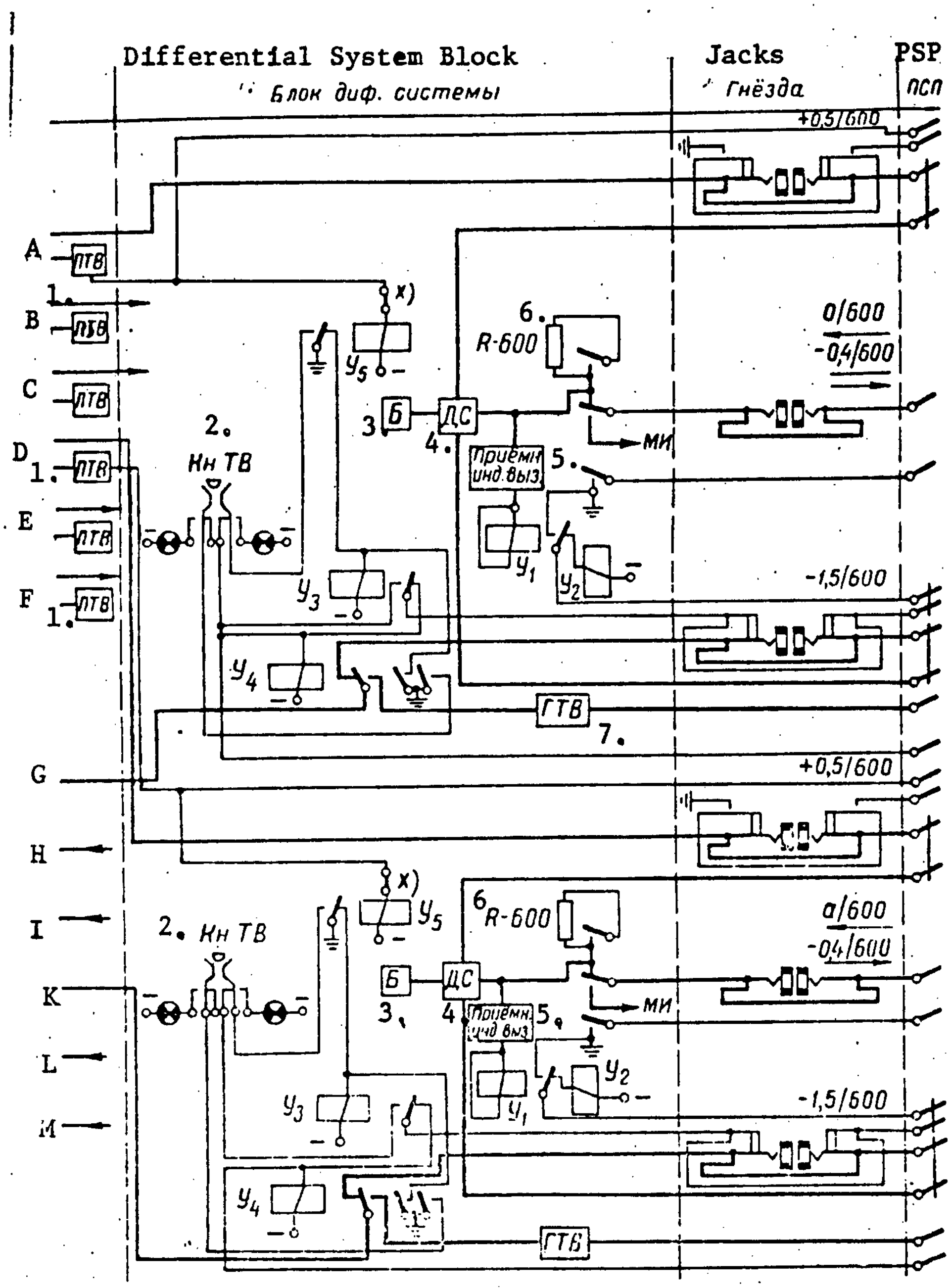


Figure 4.5.5. [Second half of Figure on page 288] Block diagram of the SIO individual conversion equipment rack of the BK-24 equipment. The jumpers are removed when working through a four-wire circuit.

[Key to first half, above]:

1. Broadcast channel;
2. 84.14 KHz rejection filter;
3. Differential system;
4. To similar equipment.



[Key to second half of Figure 4.5.5, above]:

1. PTV [voice frequency ring receiver];
2. Voice frequency ring key;
3. B [balancing network];
4. Differential system;
5. Receive and ring unit;
6. R-600 relay;
7. GTV [voice frequency ring generator].

4.6. The K-24k 24-Channel Transmission System

Figures 4.6.1 - 4.6.3.

Purpose:

Intended for multiplexing the service pairs of a coaxial cable when a K-1920 system is simultaneously operating through the coaxial pairs of the same cable.

Type of Line:

Service (balanced) pairs of KMB-4 cable with 0.9 mm diameter cores. There are five service (balanced) quads in the KMB coaxial cable. The operation of the K-24k system is organized via two service pairs of KMB-4 cable, which are located in different quads.

Note: Only one K-24k system can be organized via the service pairs of a cable.

The choice of the pairs is determined by means of measuring the near-end crosstalk attenuation from both ends of a repeater section between the third and the ninth pairs of the service circuits (the third pair is permanently assigned to the K-24k). If the magnitude of the crosstalk attenuation between these pairs is less than 9.0 Np, then the pair is chosen by means of measuring the crosstalk attenuation between the third and other pairs, included in the third and fifth quads. It is not necessary to balance the service pairs.

The Communications System: Single-cable, single-band.

Electrical Characteristics:

Line spectrum	12 - 108 KHz
The effectively transmitted passband	300 - 3,400 Hz
The number of channels which can be organized	24
The secondary multiplexing capability	See the introduction
The maximum communications range	300 km
The length of an OUP--OUP [attended repeater station] section	No more than 186 km
The nominal relative transmit level in each channel:	
At the output of the amplifier (with respect to power) when the system operates without skewing [the frequency response] at the output of an OP [terminal station], OUP or NUP [unattended repeater station]	-2.25 Np
At the output of the transmit amplifier of the OP or OUP equipment, without considering the 2.1 Np pad in the VKO [cable entrance unit]	-0.15

The input impedance from the:	
Line end	160 ohms
Station end	135 ohms
The internal noise level, referenced to the input of the amplifier for the following channels:	
24th	-15.0 Np
1st	-14.3 Np
The attenuation of amplifier nonlinearity for the case of a zero level (with respect to power) at the output:	
With respect to the second harmonic	8.5 Np
With respect to the third harmonic	11.0 Np
The average gain of a repeater station at a ground temperature of +7.5° C, at a frequency of 108 KHz	2.5 ± 0.05 Np
The permissible scatter in the attenuations of repeater sections	± 0.18 Np
The drop in the frequency response of the gain at frequencies of 17 and 103 KHz, when the line equalizer is set in the following positions:	
5 km	0.87 Np
6 km	1.05 Np
7 km	1.23 Np
The control range for the gain of amplifiers using ground referenced AGC when the ground temperature changes from -20 to +5° C, from -15 to +10° C, and from +5 to +30° C at the following frequencies:	
12 KHz	0.16 Np
108 Khz	0.10 Np
The permissible inaccuracy in the operation of the ground referenced AGC controls on an OUP—OUP control section	No more than ± 0.3 Np

The Electrical Power Supply

The station derives its power from the remote power supply of the K-1920 system:

Voltage	24 volts ± 10%
Current Consumption	0.33 amperes

Equipment Complement

Standard K-24-2 or BK-24 equipment is used at terminal and attended amplifier points for the organization of the communications channels.

Terminal Station. The rack of group devices, SGU K-24-2; the cable entrance equipment panel, VKO K-24k.

The OUP [attended] Intermediate Station. The intermediate amplifier rack; the SPU-2 or SPU-3 K-24-2; the VKO K-24k cable entrance equipment panel.

The NUP [unattended] Intermediate Station. Included in the complement of the unattended repeater is the high frequency channel and electrical power supply equipment. All of the equipment consists of the following blocks: line amplifier (2 units), low level transformer, high level transformer, temperature sensor (remote) and electrical power supply. The temperature sensors are connected into every other NUP in checkerboard order. In this case, the temperature sensor for only one transmission route is connected into each NUP. The blocks of temperature sensors are connected to the K-24k and K-1920 equipment with one TZB 4 x 4 x 0.9 cable (six pairs for the K-1920 equipment and two pairs for the K-24k). The cable is connected to the BM-1 10 x 2 box, which is the SV-NUP rack.

Note: A branching coupling, by means of which two pairs of cores are segregated, is installed at the point where the temperature sensor block for the K-24k is installed using the TZB 4 x 4 x 0.9 cable. The overall distance from the 10 x 2 box to the temperature transducer is: 20 - 25 m for the K-1920 equipment, and no more than 10 m for the K-24k equipment.

The indicated equipment is installed in the SV-NUP racks having a USS [service communications unit] or a SV-NUP without the USS of the K-1920 equipment. Sets of spare parts are provided which are nececessary for securing the blocks to the rack (bases, blank panels, screws, brackets, etc.] for the installation of the NUP K-24k equipment in the SV-NUP racks.

With the development of the K-1920 U [improved] system, all of the indicated NUP K-24k equipment will be included in the complex of the SV-NUP rack.

Cost: Pilot batch of NUP K-24k's 875 rubles

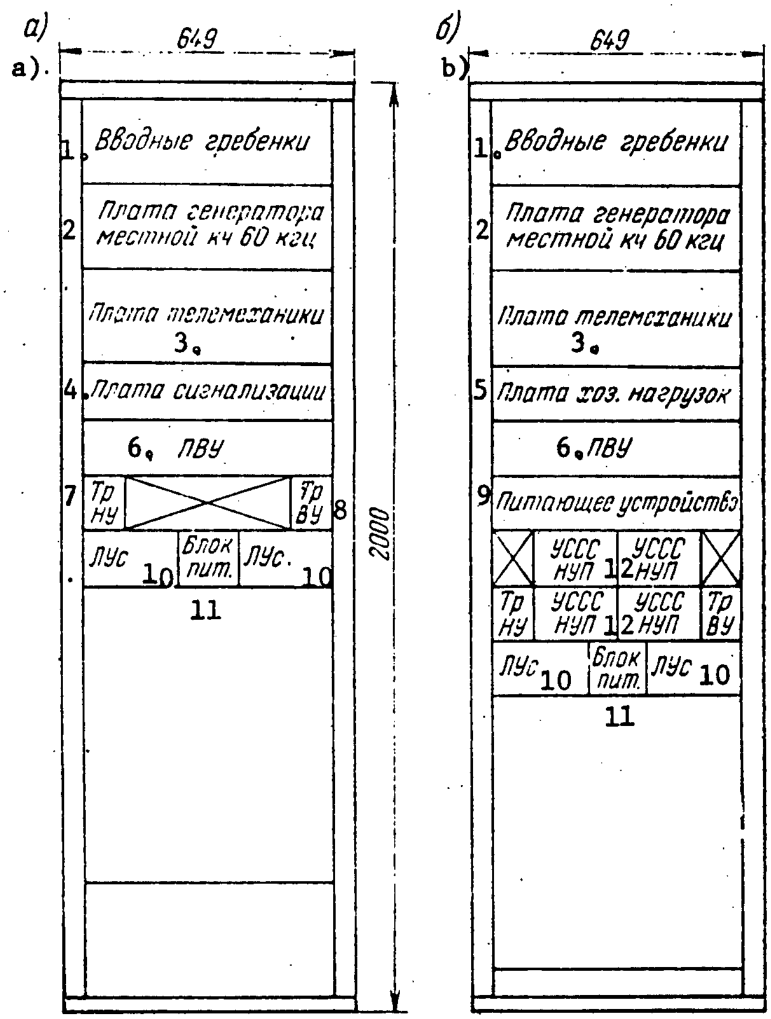


Рис. IV.6.1. Размещение оборудования аппаратуры К-24к:
а) СВ-НУП без УССС; *б)* СВ-НУП с УССС

Figure 4.6.1. The placement of the units of K-24k equipment.
a) SV-NUP without the USSS [service communications/talkback unit];
b) SV NUP with the USSS.

Key:
1. Input terminal block;
2. Generator panel for the local 60 KHz control frequency;
3. Remote control panel;
4. Signaling panel;
5. Load management panel;
6. Intercom-callup unit;
7. Low level transformer;
8. High level transformer;
9. Power supply unit;
10. Line amplifier;
11. Power supply block;
12. Unattended repeater station service communications/talkback unit.

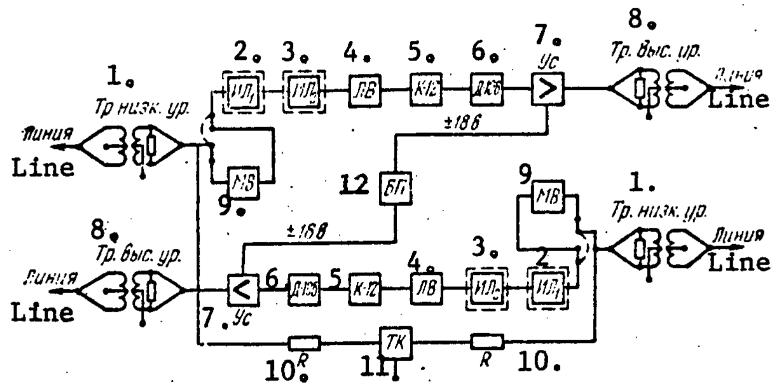


Figure 4.6.2. Block diagram of the NUP of the K-24k equipment.

Key: 1. Low level transformer;
2. Phantom line 1;
3. Phantom line 2;
4. Line equalizer;
5. K-12 filter;
6. D-108 filter;
7. Amplifier;
8. High level transformer;
9. Trunk equalizer;
10. Resistor;
11. TK [expansion unknown];
12. Power supply.

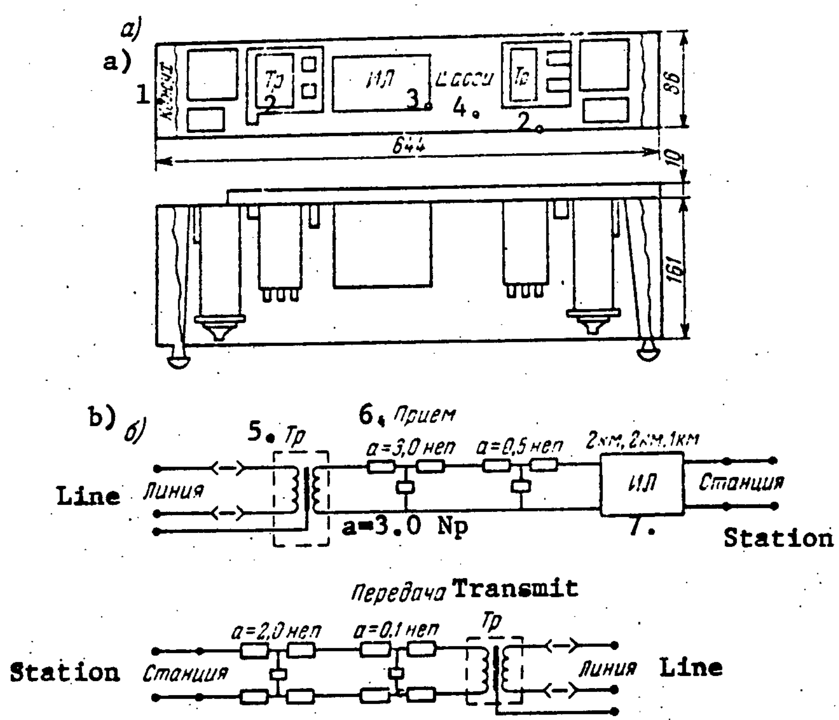


Figure 4.6.3. The VKO [cable entrance equipment] panel of the K-24k equipment.
a) Construction of the VKO panel;
b) Schematic diagram.

Key: 1. Housing;
2. Transformer;

[Key to Figure 4.6.3, continued]:

3. Phantom line;
4. Chassis;
5. Transformer;
6. Receive;
7. Phantom line.

4.7. The K-60 60-Channel Transmission System

Figures 4.7.1 - 4.7.11

Purpose:

Intended for multiplexing, balanced, non-coil-loaded cables using the following: vacuum tube equipment at terminal points and attended repeater stations; vacuum tube amplifiers of the SPUN K-24-60 equipment at unattended repeater stations, or the transistorized equipment: SPUN K-60p, NUP K-60p-2m, or NUP K-60p-4.

Type of Line:

Cable with styroflex-cord insulation: MKSB 4 x 4 x 1.2 or 7 x 4 x 1.2 when the SPUN K-24-60 or NUP K-60p amplifiers are used at the unattended repeater stations; MKSB 1 x 4 x 1.2, MKPV 1 x 4 x 1.2, or MKSA 1 x 4 x 1.2 when the NUP K-60p-4 or NUP K-60p-2m amplifiers are used at the unattended repeater stations. The use of the SPUN K-60p is covered in section 4.8.

Communications System: Two-cable, single-band.

Electrical Characteristics

Line frequency spectrum	12 - 252 KHz
Note: The inverse spectrum should be used for one of the systems working through the same quad (where the communications length is more than 250 km.	
The effectively transmitted passband	300 - 3,400 Hz
The number of channels which can be organized	60
The secondary multiplexing capability	See the introduction
The maximum length of a low frequency retransmission section for systems using the following amplifiers at the NUP's:	
K-24-60: Without a cosine corrector	1,200 km
With a cosine corrector	2,500 km
K-60p-2m, K-60p-4	1,000 km (1 x 4 x 1.2 cable)
The number of low frequency retransmission sections for all types of NUP amplifiers	5

The maximum communications range with the following amplifiers at the NUP's:

K-24-60	6,000 km
NUP K-60p-2m, NUP K-60p-4	5,000 km
K-24-60, with a cosinusoidal corrector	12,500 km

The residual channel attenuation at 800 Hz — 0.8 Np

The nominal relative voice frequency levels of the four-wire part of a channel:

At the input	-1.5 Np
At the output	+0.5 Np

The nominal relative transmit levels of the channels at the line amplifier output (with respect to power):

a) For links with the K-24-60 amplifiers:

-- Without skewing [of the frequency response] (can be used on short trunks up to 250 km)	-0.55 Np
-- With skewing with respect to the 60th channel	-0.1 Np
-- With skewing with respect to the first channel	-1.3 Np

b) For links with the K-60p-2m and K-60p-4 amplifiers at the NUP's:

-- Without skewing	-1.7 Np
-- With skewing with respect to the 60th channel	-1.25 Np
-- With skewing with respect to the first channel	-2.45 Np

Note: The levels are adjusted at an OUP in accordance with paragraph (a), and the quantities indicated in paragraph (b) are set by means of a supplemental pad, inserted at the output of the line amplifiers.

The internal noise level in the spectrum of one telephone channel referenced to the line amplifier input:

a) For an OUP	-15.2 Np	
b) With a cosine corrector (SPU-3) or OP	-14.8 Np	
c) For an NUP using the following amplifiers:		
K-24-60	-15.3 Np	
	252 KHz	12 Khz
K-60p-2m, K-60p-4	15.0	14.3

The average psophometric noise power induced in the channels of a system at the point with a relative zero level:

-- By two terminal stations with a low frequency termination of the channels — 600 pw psoph.

-- By the line channel, where the length is:

1,000 km	3,000 pw psoph.
1,200 km	3,600 pw psoph.
2,500 km	6,500 pw psoph.

-- By two terminal stations with primary group termination (HF retransmission) 233 pw psoph.

Note: It is recommended that no more than one HF transit be organized on a low frequency retransmission section when using the existing through working equipment.

-- By channel isolation equipment (for 4, 12 and 24 channels) in the following channels:

Straight through channel	30 pw psoph.
Channel for the isolation and insertion of 12 and 24 channels with a voice frequency termination	280 pw psoph
Channel for the segregation and insertion of 12 and 24 channels with primary group termination	80 pw psoph
Channel for the segregation and insertion of 4 channels	350 pw psoph

Note: At attended repeater stations, where a provision is made for channel segregation, amplifiers having three-frequency AGC should be installed. It is recommended that no more than three sets of segregation equipment be installed on a low frequency retransmission section. In this case, the edge straight-through channels should not be used for through working. A provision is made for segregating four channels in an OUP, of one (12 - 60 KHz) or two (12 - 108 KHz) of the 12 channel groups from the main spectrum.

The distribution of the noise power, induced by a line channel, in the upper channel of the system (thermal, nonlinear and linear) at NUP's with the following amplifiers:

K-24-60	1 : 1 : 2
K-60p-2m, K-60p-4	1 : 1 : 1

The attenuation of nonlinearity at the zero level at the output at a frequency of 252 KHz (with respect to power):

-- For an NUP with K-24-60 amplifiers with a gain of 6.2 Np:

a_{2h}	10.0 Np
a_{3h}	12.0 Np

-- For an NUP with K-60p-2m, or K-60p-4 amplifiers:

a_{2h}	8.5 Np
a_{3h}	11.0 Np

— For amplifiers with two- and three-frequency AGC where the amplifier gain is 6.2 Np:

a_{2h}	10.0 Np
a_{3h}	12.0 Np

The nominal attenuation of a repeater section at 252 KHz:

At the maximum ground temperature (of the cable only), a_{nom}	5.7 Np
For links using the K-60p-2m or K-60p-4 amplifiers at NUP's	3.2 Np

Notes: 1. A deviation of ± 0.15 Np is permitted on all repeater sections.

2. The deviation of up to 50% of the sections towards an increase in the attenuation by 0.25 Np is permitted. In this case, there should correspond to each lengthened segment in a section one shortened by the same amount of attenuation; the lengthened sections should not be positioned one after the other. The section preceding the OUP should not have an attenuation greater than a_{nom}.

   The number of shortened sections between an OUP using phantom lines should be no more than three, and in this case, it is desirable to locate the shortened sections close to the OUP.

3. A 0.5 neper deviation of up to 25% of the sections towards an increase in the attenuation is permitted for links which use the K-24-60 amplifier at the NUP's. In this case, there should correspond to each lengthened segment on a section three segments shortened by this same amount [of attenuation]. The lengthened sections should not be positioned one after the other. The section preceding the OUP should not have an attenuation greater than a_{nom}.

4. When planning the trunks, the interference calculations are not performed, and no deviation of the lengths of the repeater sections from the values indicated in paragraphs 1, 2 and 3 is permitted.

The nominal length of a repeater section of a trunk on an OUP-OUP section $\qquad a_{nom}/\alpha_{t\ max}$

Where a_{nom} is the nominal magnitude of the attenuation of a repeater section; $\alpha_{t\ max}$ is the attenuation factor of the cable at the maximum ground temperature.

For various types of cables, $l_{rep.sec.}$ when t_{max} = +16° C will be as follows (with the permissible deviations):

— When using K-24-60 amplifiers in the NUP's:

MKSB 1 x 4 without signal cores	16.6 $\pm$ 0.44 km
MKSB 4 x 4 without signal cores	18.7 $\pm$ 0.5 km
MKSB 7 x 4 without signal cores	19.0 $\pm$ 0.5 km
MKSA 4 x 4	19.5 $\pm$ 0.5 km
MKB 4 x 4	17.2 $\pm$ 0.45 km

-- When using the K-60p-2m or K-60p-4 amplifier at the NUP's — 10.6 ± 0.5 km

The input impedance of the equipment from the line end:

a) For all OUP's and NUP's, using the K-24-60 amplifiers at the NUP's:

With line transformers	180 ohms
Without line transformers	135 ohms
The permissible deviation in the reflection factor	$p \leq 0.15\sqrt{252/f}$, but no more than 0.3
The attenuation of two line transformers	0.12 Np

b) For links, using the K-60p-2m or K-60p-4 NUP's:

With line transformers	145 ohms
Without line transformers	135 ohms
The permissible deviation in the reflection factor	$p \leq 0.15\sqrt{250/f}$, but no more than 0.25
The attenuation of two line transformers	0.1 Np

Station gain at a frequency of 252 Khz:

Maximum gain:

a) For an NUP station (with ground referenced AGC), using the following amplifiers:

K-24-60	6.4 Np

Note: When the 2.0 ± 0.2 Np pad is inserted in the negative feedback circuit of the line amplifier, at the maximum setting of the ground referenced AGC, as well as when all line equalizers are inserted at the input to the line amplifier [sic].

K-60p-4	3.7 Np (at +18° C)
K-60p-2m	3.5 Np

b) For stations with two- and three-frequency AGC — 7.0 Np

Note: For the case of flat AGC, the 11-th position, the pads and potentiometers at the input are cut out, and all line equalizers are inserted (a_{pad} in the negative feedback circuits = 1.0 Np).

The minimum gain (with the minimum pad in the negative feedback circuit, and the setting of the AGC control is maximum):

a) For NUP stations (with ground referenced AGC), using the following amplifiers:

K-24-60	4.7 Np
K-60p-4	2.8 Np (at +18° C)
K-60p-2m	2.9 Np

b) For stations with two- and three-frequency AGC 6.0 Np

Note: For flat AGC, the 11th position, the pads and potentiometers at the input are cut out, and all line equalizers are cut out (the pad is switched out in the negative feedback circuit).

The gain is adjusted in the negative feedback circuit in steps of	0.1 Np each

Gain Control:

-- NUP's with K-24-60 amplifiers: using pads at the amplifier input	0.3, 0.6 and 1.2 Np
-- NUP's with the K-60p-2m or K-60p-4 amplifiers: using pads between the amplifying elements	0.1 x 6 = 0.6 Np
-- OUP's: using a 0.9 Np pad at the input to the amplifier and a potentiometer	0.3 x 3 = 0.9 Np

The equalizing capability of the amplifiers:

The difference in the attenuation of the constant slope network between frequencies of 247 and 17 KHz in the negative feedback circuit:

-- For NUP's having K-24-60 amplifiers with ground referenced AGC	1.2 Np
-- For NUP's with K-60p-2m or K-60p-4 amplifiers	0.75 x 2 Np
-- For OUP's with amplifiers having two- and three-frequency AGC	1.2 Np

The difference in the attenuation of the line equalizers at frequencies of 247 and 17 KHz:

-- For NUP's with K-24-60 amplifiers having ground referenced AGC:	
LV_1 [line equalizer 1]	0.6 - 2.4 in steps of 0.2 Np each
LV_2 (the line amplifiers cannot be used without LV_2)	1.2 Np
-- For NUP's with the K-60p-2m or K-60p-4 amplifiers having ground referenced AGC:	
LV [line equalizer]	0.20, 0.39 and 0.58 Np
-- For OUP's with amplifiers having two- and three-frequency AGC:	
LV_1	0.2 and 0.4 Np
LV_2	0.8 Np
LV_3 (the line amplifiers cannot be used without LV_3)	1.6 Np

The attenuation of the line equalizers at 252 KHz:

For NUP's with K-24-60 amplifiers	0.25 Np
For NUP's with the K-60p-2m or K-60p-4 amplifiers	0.10 Np
For OUP's	0.25 Np

The AGC system:

In the NUP amplifiers	Based on ground temperature
In the OUP amplifiers (AGC based on control frequencies)	Electro-thermomechanical, two- and three-frequency type

Control frequencies:

Slope	16 KHz
Curvilinear	112 KHz
Flat	248 KHz

Amplifiers with the following types of AGC are located as follows:

With ground referenced AGC	At each NUP
With two-frequency AGC for links which use the following amplifiers at NUP's:	
K-24-60	Every 160 - 170 km
NUP K-60p-2m, K-60p-4	Every 190 - 230 km
With three-frequency AGC	Every 500 - 600 km

The control range of the amplifiers having AGC:

-- For NUP's with the K-24-60 amplifiers having ground referenced AGC (when the ground temperature varies from -2 to +18° C) at the following frequencies:

12 KHz	± 0.06 Np
252 KHz	± 0.12 Np

-- For NUP's with the K-60p-2m or K-60p-4 amplifiers under the same conditions at the following frequencies:

12 KHz	± 0.03 Np
252 KHz	± 0.06 Np

Note: In the project planning, it is necessary to take into account the imprecision in the equalization of the ground referenced AGC on the OUP - OUP section. The length of the ground referenced AGC cable for a temperature gradient of from -2 to +18° C should be no more than 14 m. For other temperature drops, and where the number of NUP's runs up to four, it should be no more than 14 m, and where the number is more than four, no more than 10 m.

The values of the crosstalk attenuation between the circuits should be no less than 9.5 Np.

-- For amplifiers with two-frequency AGC:

Flat	± 0.7 Np
Slope (12 KHz)	± 0.4 Np

-- For amplifiers with three-frequency AGC:

Flat	± 0.7 Np

Slope (12 KHz)	$\pm$ 0.4 Np
Curvilinear (80 KHz)	$\pm$ 0.4 Np

Note: In the project planning, the $\pm$ 0.07 Np imprecision in the AGC control using the control frequency is to be taken into account. (A reduction in the level over the entire route of 0.07 Np at the maximum ground temperature)

Phantom lines are installed at the input to the amplifiers as follows:

-- At NUP's with K-24-60 amplifiers	Every 5 km
-- The phantom line attenuation at:	
252 KHz	1.47 Np
12 KHz	0.41 Np
-- At NUP's with the K-60p-2m or K-60p-4 amplifiers	Every 2.9 km x 2 km
-- The phantom line attenuation at:	
252 KHz	1.62 Np
12 KHz	0.48 Np
-- At OUP's [attended repeater stations]	Every 5 km
-- The phantom line attenuation at:	
252 KHz	1.47 Np
12 KHz	0.41 Np

Note: The phantom line is stipulated in a special order. (There is the option of cutting out the 0.4 Np pad of the phantom lines at the OUP's.)

The attenuation of the trunk equalizers at the input to NUP amplifiers at 252 KHz:

For the K-24-60 amplifier	0.5 Np
For NUP's with K-60p-2m or K-60p-4 amplifiers	0.3 Np

Trunk equalizers should be installed for NUP's with the following amplifiers:

K-24-60	Every 60 - 80 km
K-60p-2m or K-60p-4	Every 35 - 40 km

Notes: 1. Trunk equalizers (fixed and variable) for aligning the channels are specified in a special order.
2. No less than two variable trunk equalizers should be ordered for each OUP.

A variable cosine equalizer with a supplemental amplifier can be installed at the input to amplifiers having two- and three-frequency AGC to equalize temperature distortions. The variable cosine equalizer can correct distortions within limits of $\pm$ 0.3 Np

The cosine correcting networks should be installed at each OUP for links using the following NUP amplifiers:

K-24-60	Every 160 - 170 km
K-60p-2m or K-60p-4	Every 190 or 230 km

Notes: 1. The cosine corrector and the instrument for aligning it are stipulated in a special order.
2. In the noise calculation, the noise induced by the cosine corrector amplifier is taken into account.

The ringing system using the HF channels	Voice frequency ringing at 2,100 Hz
The number of service links:	
For trunks with the K-24-60 amplifiers:	
Trunk service communications line, MSS	1
Station-to-station service communications link, PSS	2
Sectional service communications link, USS	1
For single quad cables with K-60p-2m and K-60p-4 amplifiers:	
Trunk service communications link, MSS	1
Combined station-to-station and sectional service communications link, PSS-USS	1
The number of NUP's which can be remotely powered between two supply stations:	
a) For NUP's with the K-24-60 amplifiers when using both cables simultaneously for remote power in the following circuit configurations:	
"wire-wire"	4
"wire-ground"	8

Note: When it is necessary to disconnect one of the cables, only 50% of the links are preserved.

b) For NUP's with the K-60p-2m or K-60p-4 amplifiers when protective devices are present	Up to 20 (10 NUP's each from each OUP end)
Remote power supply circuit	"wire-wire"
In the presence of induced DC at a voltage of more than $\pm$ 15 volts, a provision should be made in the equipment for the installation of compensators with a voltage control range of	$\pm$ 70 volts

Notes: 1. In the presence of induced DC of more than 70 volts, a "wire-wire" remote power supply circuit configuration should be employed.
2. When using the K-60p-2m or K-60p-4 amplifiers in the NUP's, no provision is made for the installation of compensators, since the remote power circuit is a "wire-wire" circuit.

The permissible voltage (longitudinal e.m.f.) due to the influence of AC electrified railroads on a repeater section for links using the K-24-60 amplifier:

Long Term:

-- When one protective device is inserted in the remote power circuit at the NUP, and one protective device is provided at the OUP, and the remote power uses the following circuits:

"wire-ground"	50 volts eff.
"wire-wire"	100 volts eff.

-- When two protective devices are inserted in the circuit at the NUP, and one at the OUP, and the remote power uses a "wire-ground" circuit configuration	200 volts eff.

Short Term:

-- When the remote power uses the following circuit configurations:

"wire-ground"	750 volts eff.
"wire-wire"	930 volts eff.

The permissible voltage (longitudinal e.m.f.) due to the influence of high voltage lines on a repeater section, when the remote power uses the following circuit configurations:

"wire-ground"	750 volts eff.
"wire-wire"	930 volts eff.

The permissible voltage (longitudinal e.m.f.) due to the influence of an AC electrified railroad on a repeater section, for a link using the K-60p-2m or K-60p-4 NUP amplifiers:

Long term	75 volts eff.
Short term	250 volts eff.

The short term permissible voltage (longitudinal e.m.f.) due to the influence of high voltage lines on a repeater section	250 volts eff.

Grounds:

-- For NUP's with K-24-60 amplifiers when powered via a:

"wire-ground" circuit configuration	Two grounds: working and protective one
"wire-wire" circuit configuration	One ground, working (protective).

-- For NUP's with the K-60p-2m or K-60p-4 amplifiers, when powered via a:

"wire-ground" circuit configuration:

NUP's within a remote power section	One ground
NUP's at the end of a remote power section	Two grounds (a working and a protective one)

"Wire-wire" circuit configuration — One ground

— For OUP's and OP's [terminal stations] — Three grounds: A working and two measurement grounds.

Note: The resistance of each ground should be in accordance with GOST 464-68.

The Climatic Operational Conditions:

Attended Stations (OP's, OUP's). At temperatures of from +10 to +40° C and a humidity of 75%; short term exposure to 80% at a temperature of 25° C.

Unattended Stations for NUP's with the following amplifiers: K-60p-2m, K-60p-4. At temperatures of from -5 to +25° C and a humidity of 75%; short term exposure to 95% at a temperature of +20° C; and for the K-24-60: at temperatures of from 0 to 35° C and a humidity of 75%; short term exposure to 95% at a temperature of 20° C.

Electrical Power Supply

Voltages:

-- Terminal and attended intermediate stations (OP's and OUP'

Plate	206 volts ± 3%
Filament	21.2 volts ± 3%
Signaling	24 volts ± 10%
AC mains	220 volts +5%, -15% 48 - 51 Hz

-- Unattended repeater stations (NUP's): the remote power fed into the line (maximum) — 450 volts

-- At the terminals of the equipment being powered:

For the K-24-60 amplifiers	145 volts ± 10%
For the K-60p-2m or K-60p-4 amplifiers for:	
One system	23 volts ± 10%
Two systems	26 volts ± 10%

Current and Power Consumption

Equipment	21.2 v amps	24 v amps	206 v & remote power, amps	220 v VA
SGU [group equipment rack] for one system	2.5	-	0.3	-
Signaling	-	0.59	-	-
SGU for two systems	5.0	-	0.6	-
Signaling	-	1.0	-	-
SGNK [carrier and control frequency generator rack] (main circuit, main power)	4.5	-	0.55	0.55
The same, standby power	4.5	-	0.45	-
Signaling	-	3.0	-	-
Oscilloscope	-	-	-	12.6

[continued]

[Current and Power Consumption, continued]:

Equipment	21.2 v amps	24 v amps	206 v & remote power, amps	220 v amps
SUGN [group carrier amplifier rack] (main circuit and power)	6.0	-	0.75	-
The same, standby power	6.0	-	0.75	-
Signaling	-	1.0	-	-
SUGO-1 (main and standby power)	17.5	-	-	-
Signaling	-	1.67	-	-
Oscilloscope	-	-	-	25
TM-OUP	-	3.0	-	-
TM-NUP	-	-	0.68 (24 v)	-
SPU-2 for one system	1.6	-	0.2	-
Signaling	-	1.2	-	-
SPU-3 for one system	1.75	-	0.23	-
Signaling	-	1.2	-	-
SPU-N-U-1	-	-	0.225	-
SPU-N-U-2	-	-	0.275	-
NUP K-60p-4, K-60p-2m	-	-	0.09	-

Note: The SGNK and SUGN are being replaced by the SUGO I-1 equipment (see Section 6).

Equipment Complement

Terminal Station

a) Cable Entrance Equipment:

-- VKS 4 x 4 OUP or VKS 7 x 4 OUP for bringing in high level cables: a rack for two cables;

-- VKS-1 4 x 4 OUP or VKS-1 7 x 4 OUP for bringing in low level cables: a rack for two cables;

-- VKS-1 x 4 OP for bringing in high and low level cables, which is a rack for single quad MKSB, MKSA or MKPV cables, is used for links with K-60p-2m amplifiers in the NUP's.

Notes: 1. When using the VKS 4 x 4 OUP racks for 1 x 4 cable, the low level cable is tied into the left box, while the high level is tied into the right box of the VKS rack.

2. 135:135 line transformers can be installed for trunks with lengths up to 230 km; for trunks of greater length - 145:135 transformers.

b) The Individual Conversion Equipment: the SIP-60 rack and the STV-DS-60 rack (see Section 7).

c) The SGU K-60 Rack of Group Devices is a rack for one or two systems.

Note: The rack permits the simultaneous operation with direct and inverse spectra. On special order, the plant supplies the trunk equalizer of a 5 km phantom line

d) The SGNK Carrier and Control Frequency Generator Rack and the SUGN Group Carrier Frequency Amplifier Rack. The SGNK and SUGN racks jointly feed five K-60 systems. In this case, the SGNK feeds the individual carrier frequencies for 300 channels, and the control and group carrier frequencies for 480 channels. The SUGN supplies the following: the group carrier frequencies for 480 channels and the control frequencies for 960 channels. The SGNK and SUGN racks can be replaced by the SUGO-I-1 rack.

e) The SUGO-I Generator Equipment: a rack for eight systems (see Section 6).

f) The SPDM K-60 Remote Power Supply Equipment for links with amplifiers in the NUP's for:

-- K-24-60: Racks for 12, 24 or 48 remote power circuits for 7 x 4 cable and for 12 or 24 circuits for 4 x 4 cable.

-- K-60p-2m, K-60p-4: The DP-3 panel, for two remote power circuits.

g) The Standardized Switching-Callup Service Communications Equipment, UKVSS, in the complement of the SS-3 or SS-4 rack (SSS-7 or SSS-8) bay.

h) The remote control equipment is for links with NUP K-24-60 amplifiers.

i) The remote monitoring equipment is an instrument for all systems.

j) The primary group switching rack, SKP-1 (it is provided when no less than 10 primary groups are planned in the future), is a cabinet type rack. It is designed for 50 primary groups (see Section 1).

k) The SKPG primary group monitor rack: a rack for 50 primary groups or the SARUG (see Section 11) for a single quad cable with NUP K-60p-2m, K-60p-4 amplifiers, is a rack for 25 primary groups.

The Attended Intermediate Station

a) The Cable Entrance Equipment (just as for the terminal station);

VKS 4 x 4 OUP or VKS 7 x 4 OUP is a rack for two cables;
VKS-1 4 x 4 OUP or VKS-1 7 x 4 OUP is a rack for two cables;

For links using the K-60p-2m or K-60p-4 amplifier in the NUP's, VKS 1 x 4 OUP is used for connecting in the high and low level cables: it is a rack for four 1 x 4 MKSB, MKSA or MKPV cables.

Notes: 1. When using the VKS 4 x 4 OUP rack for 1 x 4 cable, the low level cables are brought into the left box, while the high level cables are brought into the right box of the VKS rack.
2. The line transformers of the VKO panel should have ratios of 145:135.

b) The SPU-2 K-60 rack of line amplifiers with two-frequency AGC (for filling out the equipment complement of the SPU-2, the KPU sets are supplied for one system): Racks for 1 - 4 systems.

c) SPU-3 K-60 Rack of Line Amplifiers with Three-Frequency AGC (for filling out the equipment complement of the SPU-3, the KPU-3 sets are supplied for one system): A rack for 1 - 4 systems.

Note: At the present time, the SPU-3 racks are supplied with a cosine corrector for two systems. Supplied on special order for the SPU-2 and SPU-3 racks are trunk equalizers, line equalizers and phantom lines, as well as a panel of transformers for powering the filaments with alternating current (fixed and variable trunk equalizers are provided). The cosine correctors for the SPU-3 racks should likewise be stipulated when ordering.

d) The Remote Power Supply Equipment for links with K-24-60 amplifiers: the remote power supply transmission rack, just as for the terminal station, the SPDPM K-60, is for 12, 24 or 48 remote power circuits for 4 x 4 cable, and has two racks: one for 12, and the second for 48 remote power circuits, for 7 x 4 cable.

For links using the K-60p-2m or K-60p-4 amplifiers in the NUP's: the SEP electrical power supply rack is a rack with four remote power outputs of up to 0.15 amperes (from each working PPU).

e) The UKVSS Standardized Switching-Callup Service Communications Equipment (just as for the terminal station), SS-3 or SS-4 (SSS-7 or SSS-8) is a rack.

f) The Remote Control Equipment (just as for the terminal station).

g) The Remote Monitoring Equipment (for links with the K-24-60 amplifier) is an instrument for all systems.

The Unattended Intermediate Stations

NUP's with the K-24-60 Amplifier:

a) Cable Entrance Equipment:

VKS 4 x 4 NUP or VKS 7 x 4 NUP for bringing in the high level cables: a rack for two cables.
VKS-1 4 x 4 NUP or VKS-1 7 x 4 NUP for bringing in low level cables: a rack for two cables.

b) The SPUN-U K-24-60 Intermediate Unattended Amplifier Rack is a rack for 1 - 4 systems.

Notes: 1. The SPUN K-24-60 is supplied with the following equipment complement: the SPU-N-U-4 for four systems; the SPU-N-U-2 for two systems; the SPU-N-U-1 for one system; the KPU-N-U-2, a set of two systems; the KPU-N-U-1, a one system set; and the KLU-N-U, a set of amplifiers for one system.

2. Additionally supplied on special order are the following: fixed trunk equalizer, variable trunk equalizer, line equalizer, block of thermistors (ground referenced AGC) and a power supply filter panel.

c) The NUP Service Communications Board (PVU-NUP): The board is installed in the VKS rack of the NUP. The service communications amplifiers are included in the SPUN complement.

d) The Remote Control Panel.

e) The NUP Remote Monitor Unit: A panel of eight systems or two panels of 14 systems (installed in the VKS).

The NUP with the K-60p-2m or K-60p-4 Amplifiers: A station for 1 - 2 systems.

Notes: 1. The NUP K-60p-2m station has been taken out of production.

2. Included in the equipment complement of the NUP K-60p-4 station are: The NUP chassis with the cable entrance unit, four entrance modules and amplifier modules, the number and type of which are stipulated when ordering.

3. Supplied on special order are: the high frequency and low frequency trunk equalizers, MV's, the high and low frequency phantom lines, IL's, the multifrequency through monitor receiver, MPKP, the remote monitor block (GPK and K), the remote power monitor block, KDP, and the PPU-3 panel.

4. Two small type amplifier modules are ordered to complete the equipment complement with a second system.

5. Supplied on special order is an operational set of spare blocks, parts and tools.

6. The NUP K-60p-4 stations, in contrast to the NUP K-60p-2m's, have remote monitor equipment, which provides for the capability of determining a damaged section of a cable or NUP equipment. The remote control system makes it possible to maintain service communications from the OUP to the location of the fault. See Table 1 for variants of the equipment complement of the NUP K-60p-4. [Table 4.7.1].

Construction

Terminal Stations (OP's):

SGU K-60; SGNK; SUGN. Racks with panels mounted on both sides. The rack dimensions are 2,500 x 648 x 464 mm.

Attended Intermediate Stations (OUP's):

SPU-2. Racks with panels mounted on both sides. The rack dimensions are 2,500 x x 648 x 464 mm. The dimensions of the KPU-2 set are 790 x 648 x 464 mm.

SPU-3. A rack with panels mounted on both sides. The rack dimensions are 2,500 x 648 x 464 mm. The dimensions of the KPU-3 set are 1,020 x 648 x 464 mm.

Unattended Intermediate Stations:

SPU-N-U-1 — 4: Rack with panels mounted on one side. The dimensions are 2,505 x 644 x 247 mm.

KPU-N-U-2. The dimensions are 1,225 x 644 x 247 mm.

KLU-N-U-1. The dimensions are 118 x 644 x 247 mm (one amplifier).

NUP K-60p-2m }
NUP K-60—4 } See Figure 4.7.10.

Table 4.7.1.

Variants of the Equipment Complement of NUP's with Amplifier Modules on an OUP—OUP Section

1. Количество НУП на секции ОУП-ОУП	2. Порядковый номер НУП	3. Направление передачи	№ вч систем 4.	Усилительные кассеты вч с ДП и нч 5.	Усилительные кассеты вч с ДП 6.	Усилительные кассеты вч 7.
Четное Even	Нечетный Odd	А—Б A – B	I	×		
			II			×
		Б—А B – A	I			×
			II		×	
	Четный Even	А—Б A – B	I		×	
			II			×
		Б—А B – A	I			×
			II	×		
Нечетное Odd	Четный Even	А—Б A – B	I	×		
			II			×
		Б—А B – A	I			×
			II	×		
	Нечетный odd	А—Б	I		×	
			II			×
		Б—А	I			×
			II		×	

Примечание. × — наличие кассет.

Key: 1. Number of unattended repeater stations on the OUP—OUP [attended repeater station] section;
2. The sequential number of the NUP;
3. The transmit directions;
4. Number of the HF systems;
5. Low frequency and HF amplifier modules with remote power;
6. High frequency amplifier modules with remote power;
7. High frequency amplifier modules.

Note: X - The presence of the modules.

Weight and Cost

Equipment	Weight, kg	Price, rubles
SGU-1 K-60	300	2,726
SGNU-2 K-60	460	4,780
SGNK	290	2,275
SUGN	290	3,500
SPU-2 for one system	130	1,506
KPU-2 for filling out the equipment complement of the SPU-2	65	868
SPU-3 for one system	200	1,215
KPU-3, for filling out the equipment complement of the SPU-3	80	1,092
SPU-N-1	120	1,296
SPU-N-2	185	1,756
SPU-N-4	370	3,522
KPU-N-U-2	150	1,288
KLU-N-U-1	30	336
NUP K-60p-4, including:		
The NUP with input devices	100	375
Input modules	12	97
Amplifier modules with low and high frequency blocks with remote power	8	240
Amplifier modules with high frequency blocks with remote power	8	250
Amplifier modules with high frequency blocks	8	310
The EK-NUP-K-60p-4 operational set	-	2,765

[Key to Figure 4.7.1, (page 311)]

1. Power distributor panel for the group carrier frequencies;
2. Panel of rejection filters;
3. Panel of primary group converters for the transmission of groups one and four;
4. Panel of primary group converters for the transmission of groups two and five;
5. Panel of primary group converters for the transmission of group three;
6. Panel of secondary, transmit, group converters;
7. PKK-248 [248 KHz] control channel receiver panel;
8. PKK-16 control channel receiver panel;
9. PKK-112 control channel receiver panel;
10. Panel for an amplifier having three-frequency AGC
11. Signaling and fuse panel;
12. Panel of secondary, receive, group converters;
13. Panel of primary group converters for the reception of group 3;
14. Panel of primary group converters for the receptions of groups 2, 5;

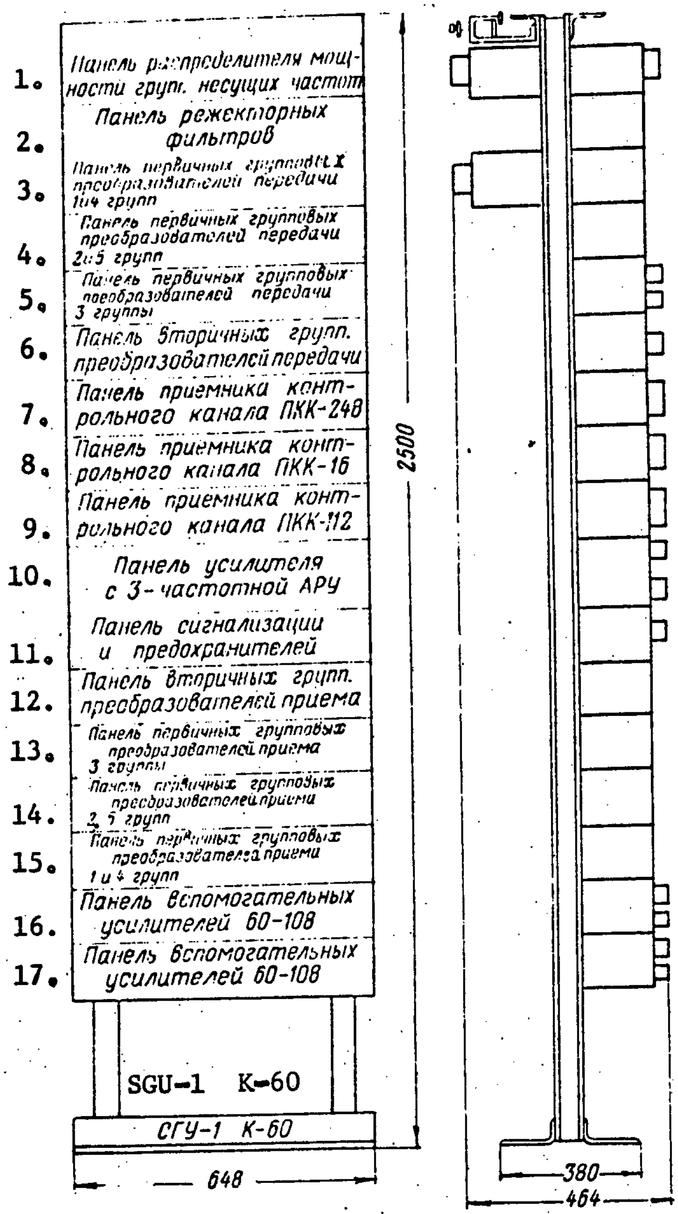


Figure 4.7.1. The placement of the equipment in the rack of group devices, SGU, of the K-60 equipment (for one system).

[Key continued from preceding page]

15. Panel of primary group converters for the reception of groups 1 and 4;
16. Panel of 60 - 108 [KHz] auxiliary amplifiers;
17. Panel of 60 - 108 [KHz] auxiliary amplifiers.

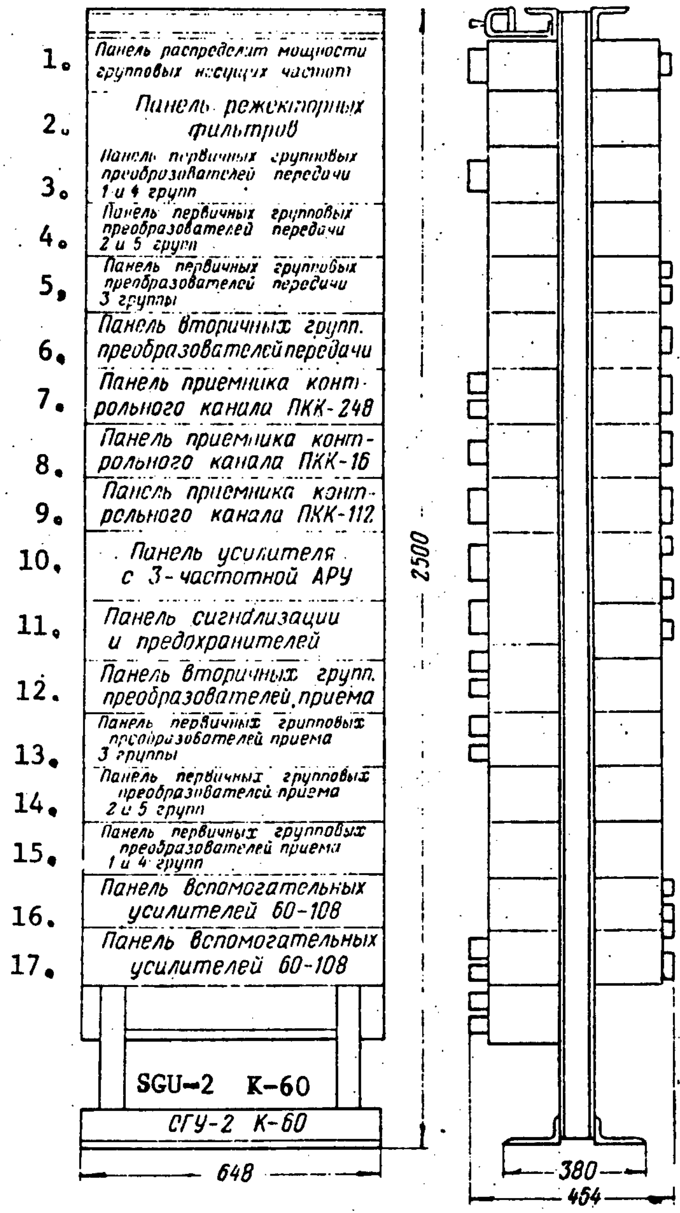


Figure 4.7.2. The placement of the equipment in the rack of group devices, SGU, of the K-60 equipment (for two systems).

Key: 1. Power distributor panel for the group carrier frequencies;
2. Panel of rejection filters;
3. Panel of the primary group converters for the transmission of groups 1 and 4;
4. Panel of the primary group converters for the transmission of groups 2 and 5;
5. Panel of the primary group converters for the transmissions of group 3;

[Key to Figure 4.7.2, continued]:

6. Panel of secondary, transmit, group converters;
7. PKK-248 [KHz] control channel receiver panel;
8. PKK-16 [KHz] control channel receiver panel;
9. PKK-112 [KHz] control channel receiver panel;
10. Panel for the amplifier with three-frequency AGC;
11. Signaling and fuse panel;
12. Panel for the secondary group converters, receive;
13. Panel of the primary group converters for the reception of group 3;
14. Panel of the primary group converters for the reception of groups 2 and 5;
15. Panel of the primary group converters for the reception of groups 1 and 4;
16. Panel of 60 - 108 [KHz] auxiliary amplifiers;
17. Panel of 60 - 108 [KHz] auxiliary amplifiers.

[Key to Figure 4.7.3, page 314]:

1. Receive, group amplifier;
2. Control channel receiver;
3. STR [?matching transformer?];
4. [Either variable or fixed slope network];
5. Pad;
6. D-252 filter;
7. VGP pr [?secondary group converter, receive?];
8. D-552 filter;
9. 312 - 552 KHz amplifier;
10. PRPG [expansion unknown];
11. From the VKS [cable entrance rack];
12. Group amplifier, transmit;
13. BPKCh [?block of control channel receivers?];
14. D-252 filter;
15. VGP per [?secondary group converter, transmit?];
16. 312 - 552 KHz amplifier;
17. Group 5;
18. Group 2;
19. PF [bandpass filter];
20. PRPG;
21. VPG [?secondary group converter?];
22. PGP [?primary group converter?];
23. 60 - 108 KHz amplifier;
24. 564 KHz power distributor;
25. Group carrier frequency power distributor;
26. To the SIO [individual conversion equipment rack];
27. Transformer;
28. RF-104 [104 KHz rejection filter];
29. 84.14 KHz power distributor.

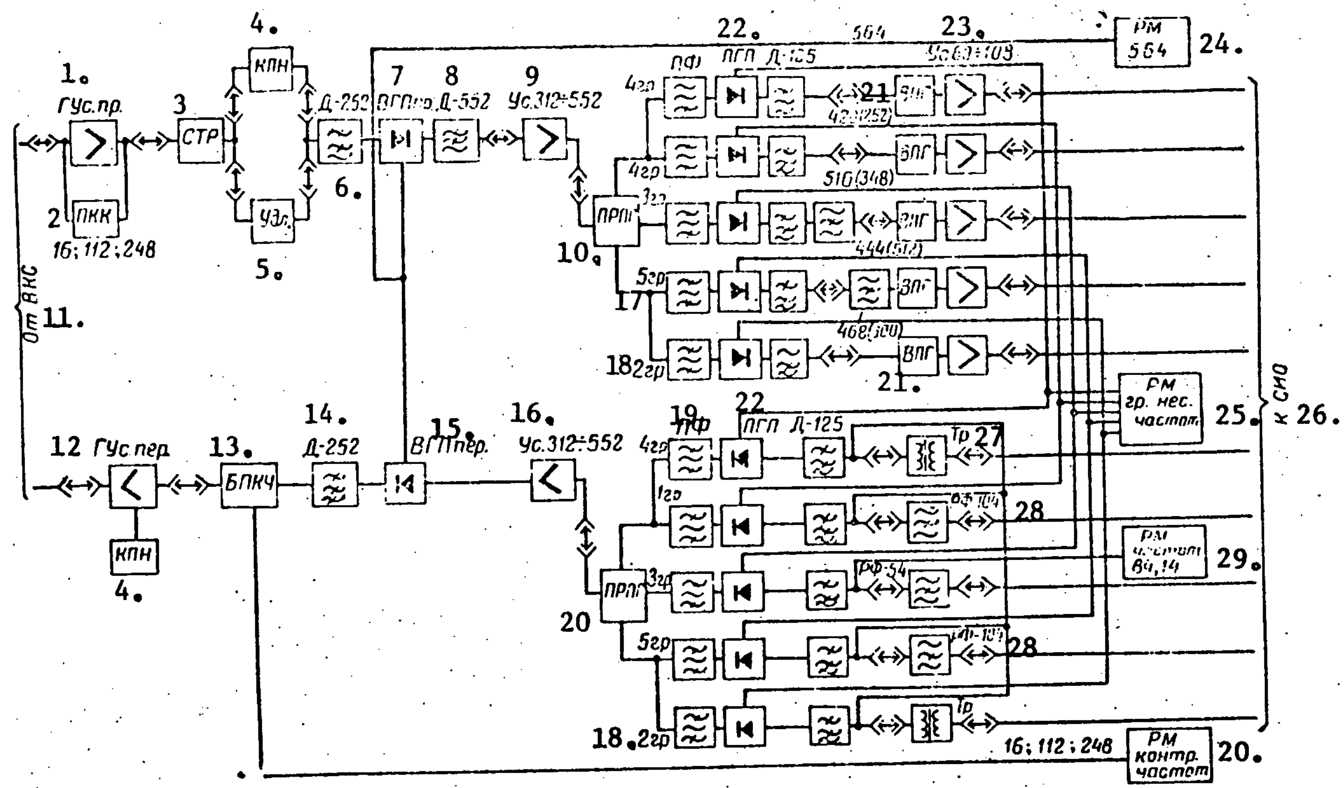


Рис. IV.7.3. Блок-схема стойки групповых устройств СГУ аппаратуры К-60

Figure 4.7.3. Block diagram of the rack of group devices, SGU, of the K-60 equipment.

[Key on preceding page]

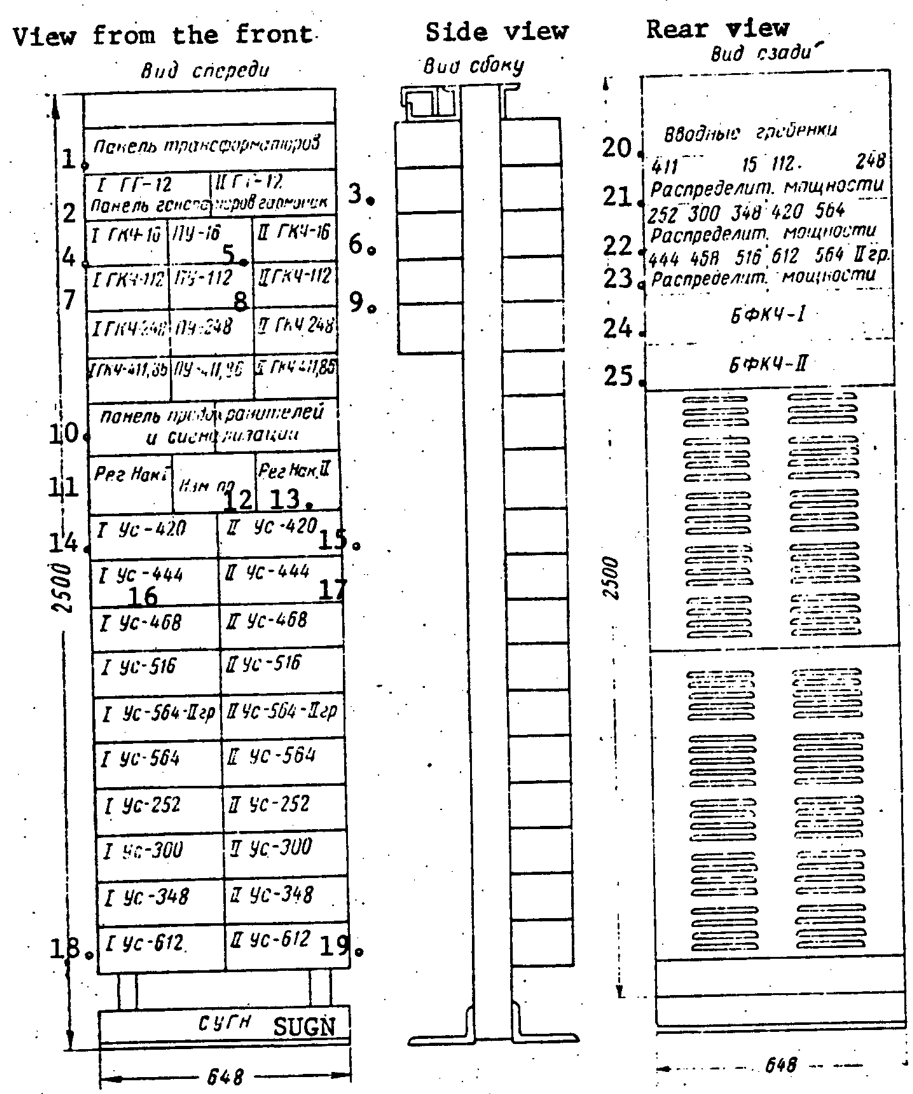


Figure 4.7.4. The placement of the equipment in the group carrier frequency amplifier rack, SUGN, of the K-60 equipment.

Key: 1. Panel of transformers;
2. I GG-12 [12 KHz harmonic generator I], panel of harmonic generators;
3. II GG-12, panel of harmonic generators;
4. I GKCh-16 [16 KHz control frequency generator 1];
5. PU-16 [16 KHz switching unit];
6. II GKCh-16 [16 KHz control frequency generator 2];
7. I GKCh-112;
8. PU-112 [112 KHz switching unit];
9. II GKCh-112 [112 KHz control frequency generator 2];
10. Fuse and signaling panel;

[Key to Figure 4.7.4, continued]:

11. Slope type level control I;
12. Receive [?or converter?] meter;
13. Slope type control II;
14. I Us-420 [420 KHz amplifier 1];
15. II Us-420 [420 KHz amplifier 2];
16. I-Us-444;
17. II Us-444;
18. I Us-612 [612 KHz amplifier 1];
19. II Us-612;
20. Input terminal blocks;
21. 411, 15, 112 and 248 KHz power distributors;
22. 252, 300 , 348, 420 and 564 Khz power distributors;
23. 444, 468, 516, 612 and 564 group II power distributors;
24. BFKCh-I [?block of control frequency filters 1?]
25. BFKCh-II.

[Key to Figure 4.7.5 (page 317)]:

1. Power distributor;
2. Switcher;
3. I FGN 612 [612 KHz group carrier filter 1];
4. I Us 612 [612 KHz amplifier 1];
5. II FGN 612 [612 KHz group carrier filter 2];
6. I GKCh-16 [16 KHz control frequency generator 1];
7. II GKCh-112 [112 KHz control frequency generator 2];
8. I GKCh-248 [248 KHz control frequency generator 1];
9. To the PRP [manual switching panel];
10. FGN-564 [564 KHz group carrier filter];
11. I Us-564 [564 KHz amplifier 1];
12. Group 2, 564 KHz power distributor;
13. To the BFKCh I, II [?blocks of control frequency filters 1 and 2];
14. I FGN 516 [516 KHz carrier frequency filter 1];
15. FGN 564 [564 KHz group carrier filter];
16. II FGN 516 [516 KHz group carrier filter 2];
17. I FGN 468;
18. 84.14 KHz power distributor;
19. FINCh 96 [96 KHz individual carrier frequency filter];
20. FINCh 104;
21. BFKCh I;
22. From the 420 KHz power distributor;
23. From the group 2, 564 KHz power distributor;
24. Pr 4/12 [expansion unknown];
25. Upr Napr [?routing control or control route?]
26. I GG-12 [12 KHz harmonic generator 1];
27. NU [expansion unknown];
28. From the BUPU [expansion unknown];
29. PRP [manual switching panel];

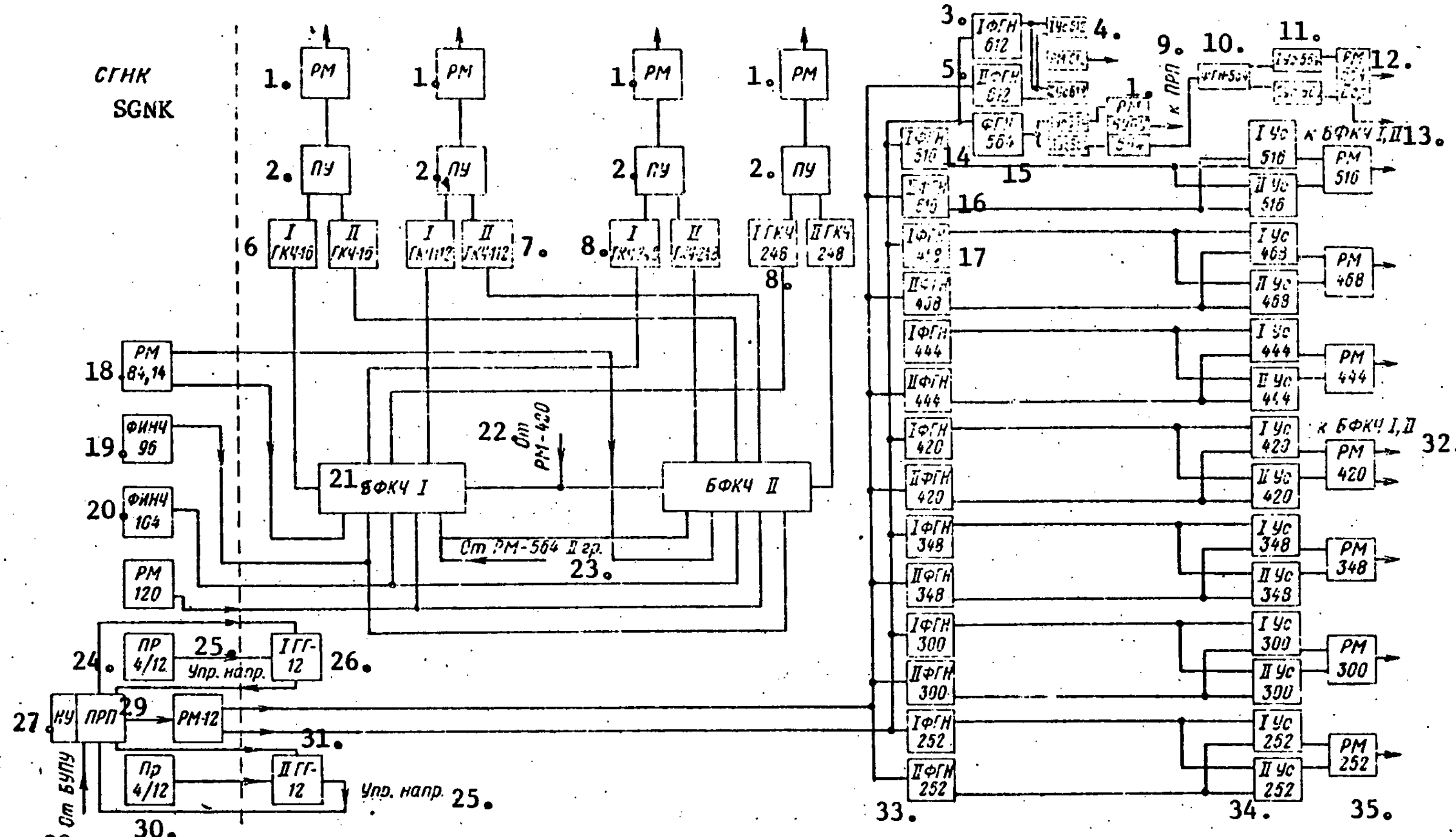


Рис. IV.7.5. Блок-схема стойки усилителей групповых несущих частот СУГН аппаратуры К-60

Figure 4.7.5. Block diagram of the group carrier frequency amplifier rack, SUGN, of the K-60 equipment.

[Key, continued from preceding page]:

30. Pr 4/12;
31. II GG-12 [12 KHz harmonic generator 2];
32. To the BFKCh I/II [?control frequency filter blocks 1/2?]
33. II FGN 252 [252 KHz group carrier filter 2];
34. 252 KHz amplifier 2;
35. 252 KHz power distributor.

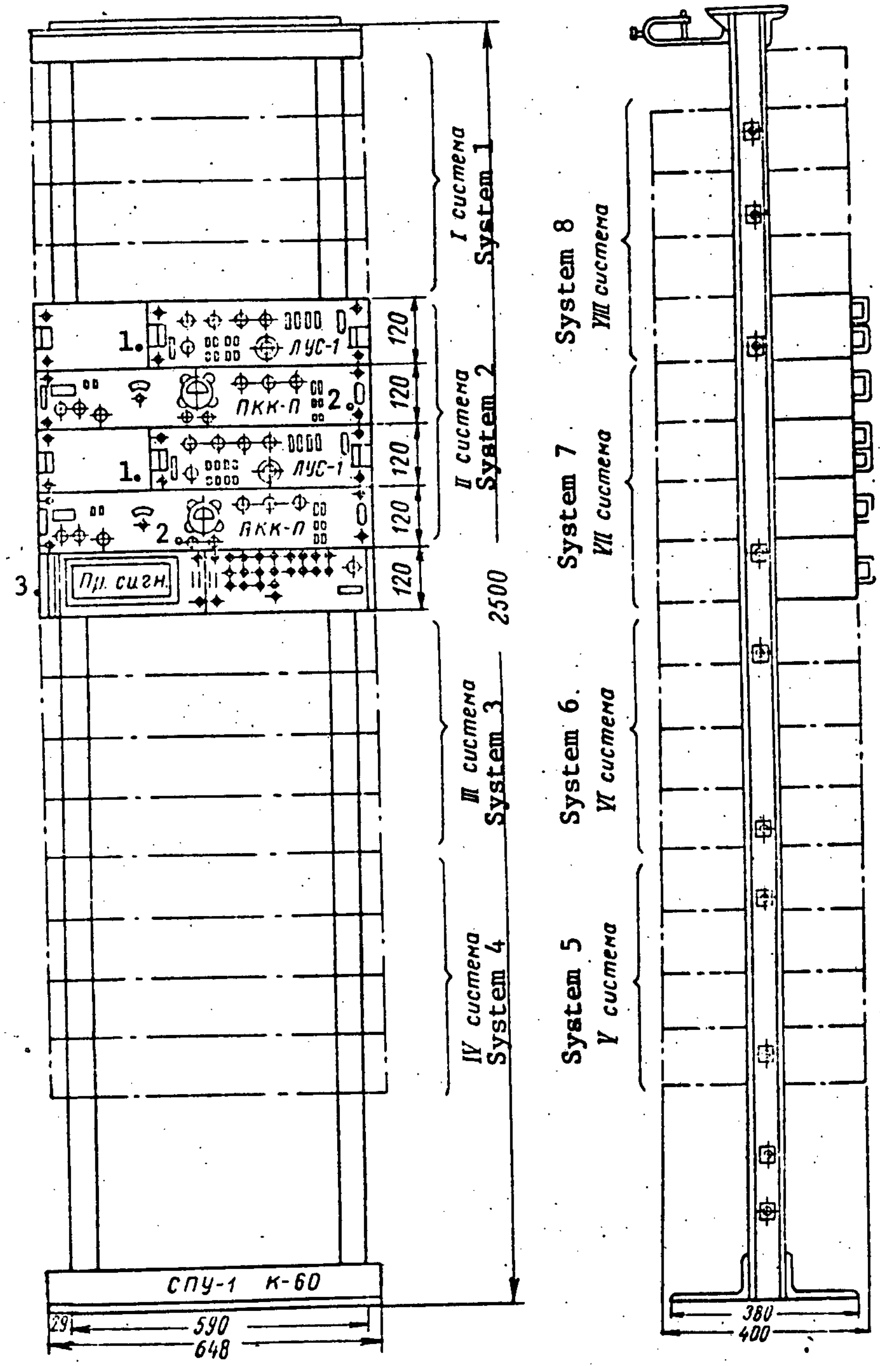


Figure 4.7.6. The placement of the equipment in the rack of intermediate amplifiers with single frequency AGC, the SPU-1, of the K-60 equipment.

Key: 1. Line amplifier 1;
2. Flat type control channel receiver;
3. Signaling receiver.

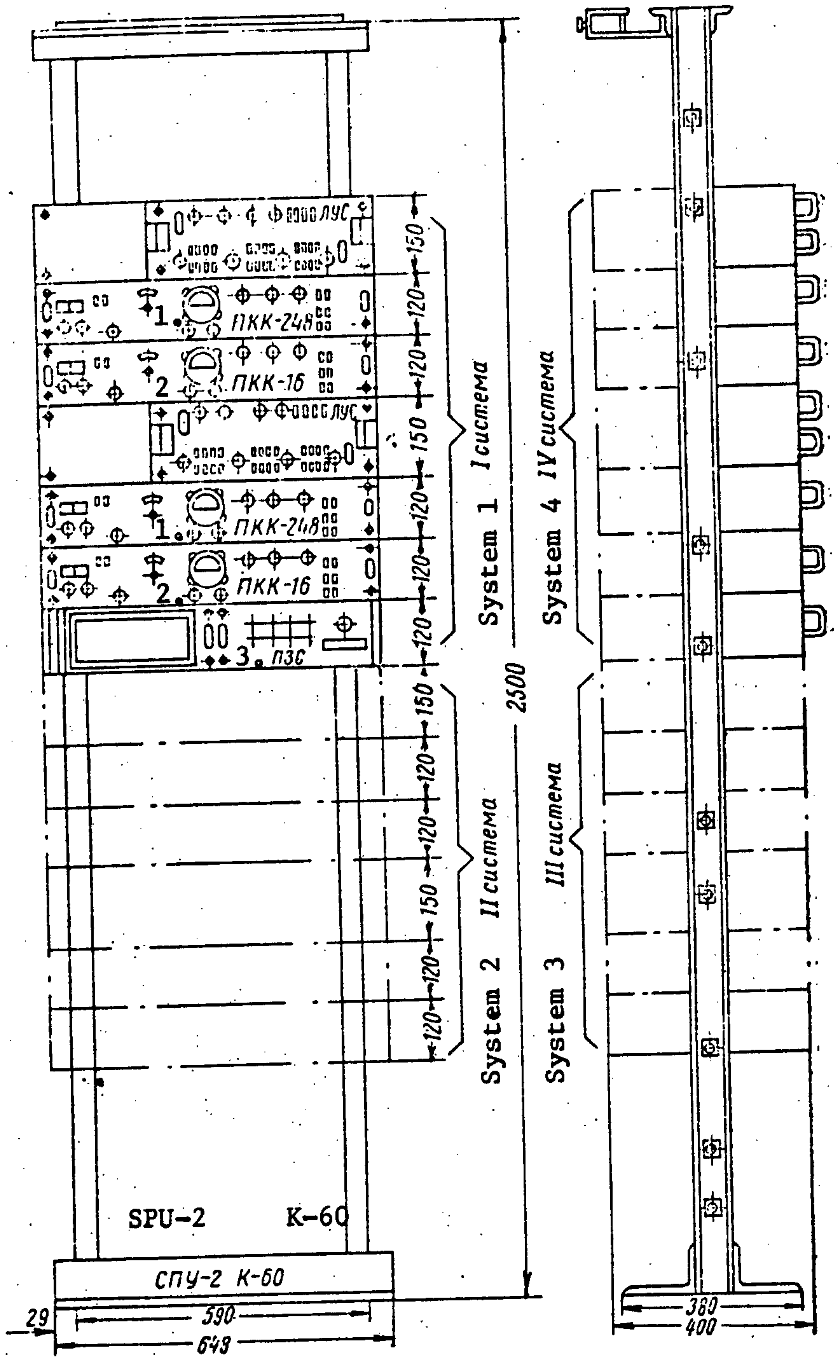


Figure 4.7.7. The placement of the equipment in the rack of intermediate amplifiers with two-frequency AGC, the SPU-2, of the K-60 equipment.

Key: 1. 248 KHz control channel receiver;
2. 16 KHz control channel receiver;
3. PZS [?fuse and signaling panel?].

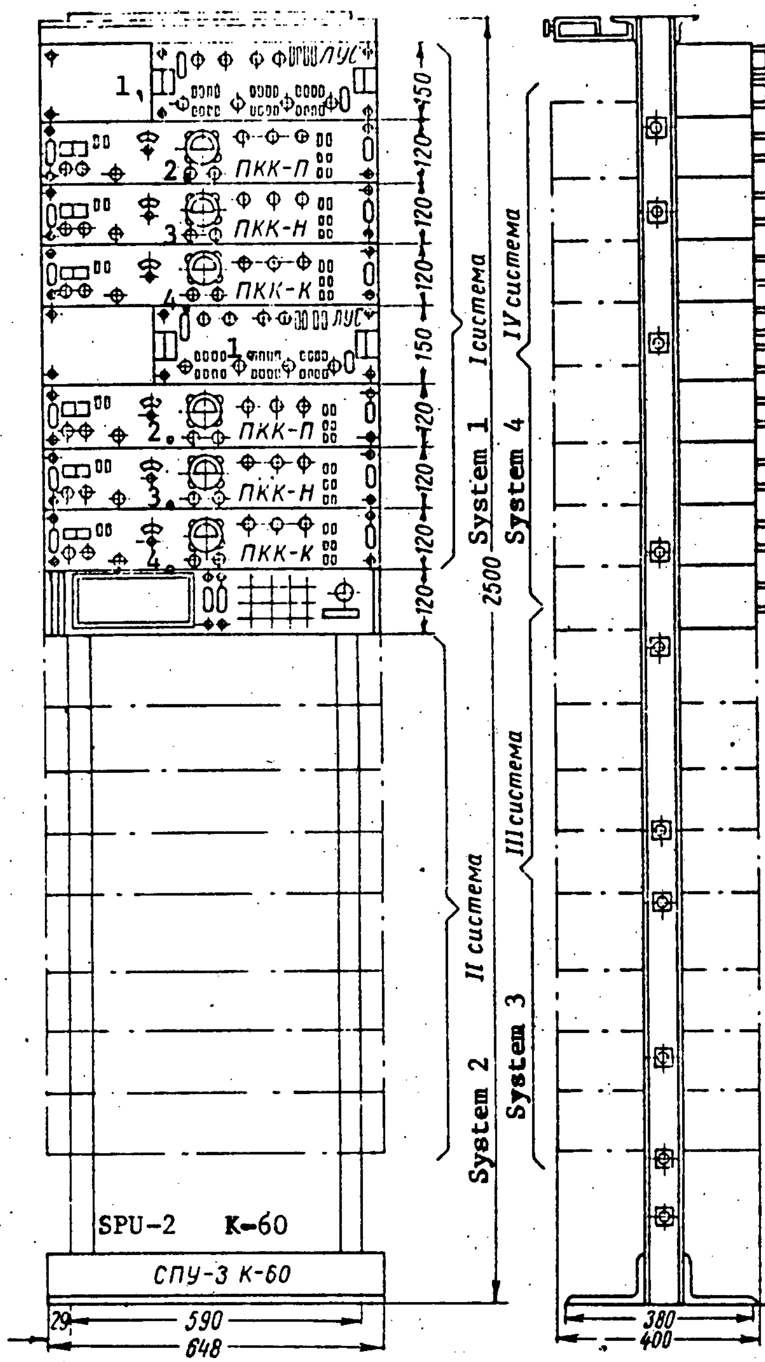


Figure 4.7.8. The placement of the equipment in the rack of intermediate amplifiers with three-frequency AGC, the SPU-3, of the K-60 equipment (taken out of production).

Key:
1. Line amplifier;
2. Flat type control channel receiver;
3. Slope type control channel receiver;
4. Curvilinear type control channel receiver.

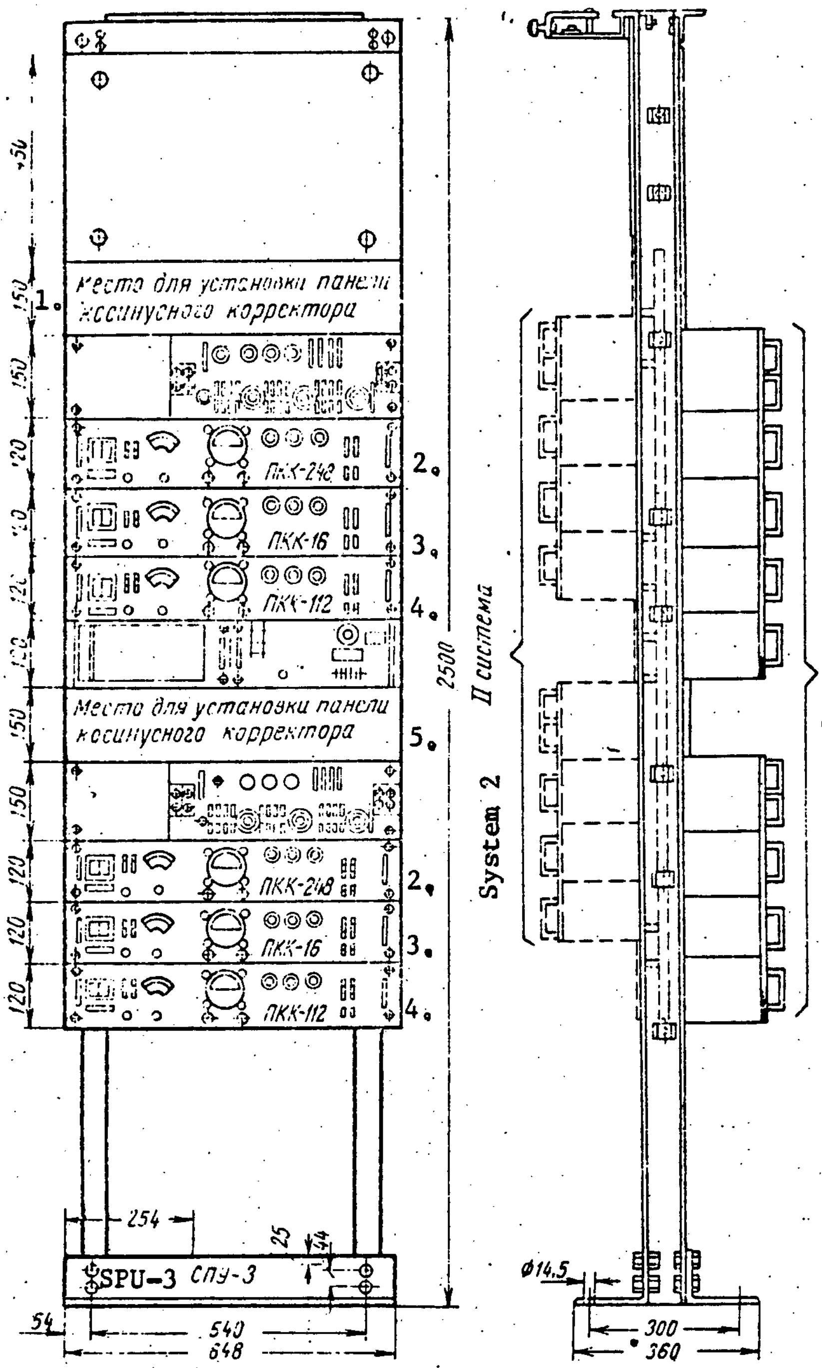


Figure 4.7.9. The placement of the equipment in the rack of intermediate amplifiers with three-frequency AGC, the SPU-3, of the K-60 equipment.

Key: 1. Location for the mounting of a cosine corrector panel;
2. 248 KHz control channel receiver;
3. 16 KHz control channel receiver;
4. 112 KHz control channel receiver;
5. Location for the mounting of a cosine corrector panel.

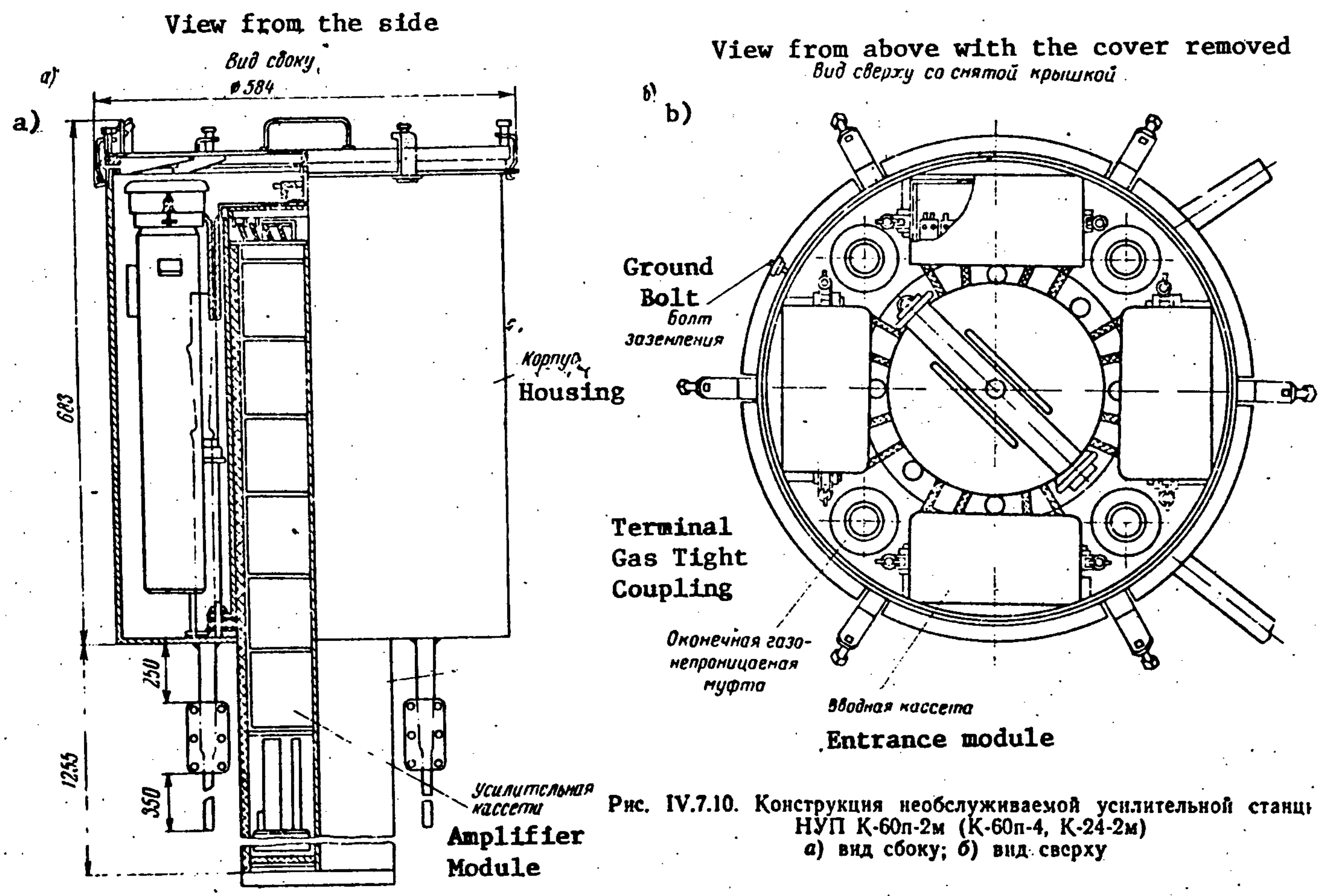


Рис. IV.7.10. Конструкция необслуживаемой усилительной станци НУП К-60п-2м (К-60п-4, К-24-2м)
а) вид сбоку; б) вид сверху

Figure 4.7.10. The construction of the NUP K-60p-2m (or K-60p-4, K-24-2m) unattended repeater station:
a) View from the side; b) View from above.

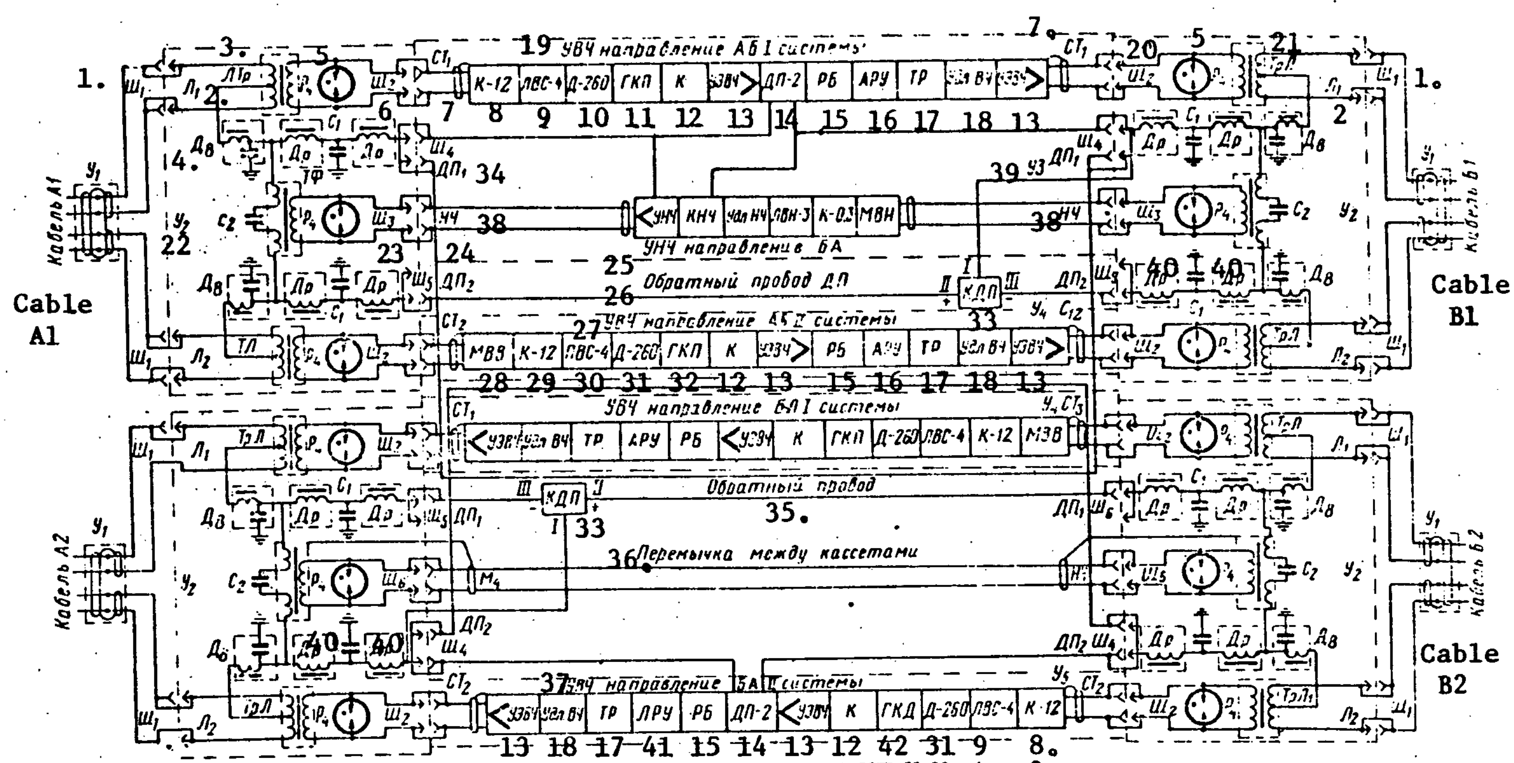


Рис. IV.7.11. Блок-схема аппаратуры НУП К-60п-4 на 2 системы

Figure 4.7.11. Block diagram of the NUP K-60p-4 set for two systems.

Key:
1. Sh_1 [box 1];
2. L_1 [line 1];
3. Line transformer;
4. D8 filter;
5. R_4 [discharger];
6. Sh_2 [box 2];
7. St_1 [Matching transformer 1];
8. K-12 filter;
9. LVS-4 [expansion unknown];
10. D-260 filter;
11. GKP [expansion unknown];
12. K [corrective network];
13. UEVCh [high frequency amplifier element];
14. DP-2 [remote power circuit 2];
15. RB [expansion unknown];
16. ARU [automatic gain control, AGC];
17. TR [expansion unknown];
18. High frequency pad;
19. High frequency amplifier for the A - B direction of system 1;

[Key to Figure 4.7.11, continued]

20. Sh_2 [box 2];
21. Line transformer;
22. U_2 [expansion unknown];
23. Dr [choke];
24. DP_2 [remote power circuit 2];
25. Low frequency amplifier for direction B-A;
26. Remote power return wire;
27. High frequency amplifier for direction A-B of system 2;
28. MVV [high frequency trunk equalizer];
29. K-12 filter;
30. PVS-4 [expansion unknown];
31. D-260 filter;
32. GKP [expansion unknown];
33. KDP [unknown type of remote power supply unit];
34. DP_1 [remote power circuit 1];
35. Return wire;
36. Jumper between modules;
37. High frequency amplifier for direction B - A of system 2;
38. NCh [low frequency];
39. UZ [?protective device?];
40. Dr [choke];
41. LRU [?line level control?].

4.8. The K-60p 60-Channel Transmission System

Figures 4.8.1 - 4.8.23.

Purpose:

Intended for multiplexing balanced, non-coil-loaded cable communications lines. The K-60p equipment for OP's, OUP's and NUP's is completely transistorized.

Type of Line

Balanced cables with copper cores, of the MKS, MK or MKSA type having a capacity of 4 x 4 x 1.2 or 7 x 4 x 1.2, as well as MKPV type cable and those similar to it with a capacity of 1 x 4 (where equipment of the K-60p-4 system is used in the NUP's).

Communications System: Two-cable, single band.

Electrical Characteristics:

Line frequency spectrum	12 - 280 KHz
Line spectrum for telephone channels	12 - 252 KHz
Line spectrum for remote monitoring	252 - 280 KHz

Note: The inverse spectrum should be employed in one of the systems working through one quad (where the communications length is more than 250 km).

The effectively transmitted passband	300 - 3,400 Hz
The number of channels which can be set up	60
The secondary multiplexing capability	See the introduction.
The maximum length of a low frequency retransmission section	2,500 km
The number of low frequency retransmission sections	5
The maximum communications range	12,500 km
The residual channel attenuation at 800 Hz	0.8 Np
The nominal relative levels with respect to the voice frequencies for the four-wire part of a channel:	
At the input	-1.5 Np
At the output	+0.5 Np
The nominal relative transmit levels for the channels at the line amplifier input, with respect to power:	
-- Without skewing [of the frequency response] (can be used on short trunks up to 250 km)	-0.55 Np
-- With skewing: With respect to the 60th channel	-0.1 Np
With respect to the 1st channel	-1.3 NP
The internal noise level, referenced to the line amplifier input: NUP	-15.2 Np (248-252 KHz) -14.8 Np (12 - 16 KHz) -14.8 Np (12 KHz)
OUP-3 (taking into account the interference introduced by the cosine corrective network)	-14.8 Np (248-252 KHz) -14.4 Np (12 - 16 KHz)
The average psophometric noise power at the relative zero level point, induced in the channels of the system:	
-- By the line channel, where the communications length is 2,500 km	7,500 pw
-- By the conversion equipment of the terminal and retransmission stations where the number of retransmissions is, just as in the conventional calibration circuit for a cable with balanced pairs and considering the load variants	2,100 pw
By two terminal stations with a voice frequency termination of the channels, or by one retransmission station	No more than 500 pw
By two terminal stations with primary group termination or by one through-working station	No more than 200 pw

-- By the channel segregation equipment (for 4, 12 and 24 channels) in the following channels:

Straight through	30 pw
For the segregation and insertion of four channels	350 pw
For the segregation and insertion of 12 and 24 channels with voice frequency termination	280 pw
For the segregation and insertion of 12 and 24 channels with primary group termination	80 pw

Note: In an OUP, a provision is made for the option of segregating four channels of one (12 - 60 KHz) or two (12 - 108 KHz) 12-channel groups from the main spectrum. A provision is likewise made for the organization of HF through working with respect to the primary and secondary groups. On one low frequency retransmission section, it is permissible to include no more than one HF through working section when using the existing through working equipment, as well as no more than three isolation points, and in this case, the edge straight through channels should not be used for through working. At an OUP, where channel isolation is provided, amplifiers should be installed having three frequency AGC.

The distribution of the noise power induced by a line channel in the upper channel of a system (thermal, nonlinear, linear): 1 : 1 : 2

The nonlinearity attenuation for the case of a zero level at the output of the OP, OUP or NUP amplifiers at a frequency of 252 KHz (with respect to power) and an amplifier gain of 6.0 Np:

a_{2h}	10 Np
a_{3h}	12.5 Np

The nominal attenuation of a repeater section at 252 KHz at the maximum ground temperature (of only the cable), α_{nom} 5.9 Np

Note: Where lengthened repeater sections are present on an OUP-OUP section, the following inequality should be observed:

$$\sum_{1}^{n}\left(e^{2\Delta Q_i}-n\right)\leqslant\sum_{1}^{k}\left(1-e^{-2\Delta Q_j}\right).$$

where k is the number of shortened sections which compensate for the amount of lengthening based on the thermal noise; n is the number of lengthened segments on the OUP-OUP section (n should not be more than three); ΔQ_i is the attenuation of a lengthened section with respect to the amount of attenuation of a section of nominal length, -5.9 Np, where the ground temperature t_{max} should not be more than 0.6 Np; ΔQ_j is the amount of the decrease in the attenuation of a shortened section with respect to the attenuation of a section of nominal length, 5.9 Np.

It is desirable to locate shortened section close to the OUP's

If the inequality is not observed, it is necessary to again break up the repeater sections.

The nominal length of a repeater section of a trunk on an OUP–OUP section Where a_{nom} is the nominal attenuation of the repeater section; α_t is the attenuation factor of the cable at the maximum ground temperature.	$a_{nom}/\alpha_{t\ max}$
The nominal lengths of repeater sections for the following cables:	
MKS 4 x 4 x 1.2	19.4 km
MKS 7 x 4 x 1.2	19.7 km
MK 4 x 4 x 1.2	17.8 km
The input impedance of the equipment from the line end:	
-- With line transformers (OP, OUP and NUP)	170 ohms
-- Without line transformers: NUP's	150 ohms
OP's, OUP's	135 ohms
The permissible deviation in the reflection factor of a station	$p \leq 0.12\sqrt{252/f}$, but no more than 0.2
The attenuation of two line transformers	0.1 Np
The gain of the station at 252 KHz:	
Maximum Gain:	
For an NUP station (with ground referenced AGC)	6.3 Np
For OP and OUP stations with two and three frequency AGC	7.0 Np
Note: The gain is indicated for the maximum setting of the AGC controls.	
Minimum Gain (with the minimum attenuation pad in the negative feedback circuit, the AGC controls are set at maximum):	
For an NUP station (with ground referenced AGC)	5.15 Np
For OP and OUP stations with two- and three-frequency AGC	6.85 Np
The gain is adjusted in the negative feedback circuit using pads of	0.05, 0.1, 0.2, 0.4 and 0.8 Np
The equalizing capability of the amplifiers:	
The difference in the attenuation of the constant slope network between frequencies of 247 and 17 KHz in the negative feedback circuit	1.5 Np
The attenuation of the line equalizer for the following cables:	
MKSB	1.95, 2.14, 2.33, 2.53, 2.72 and 2.91 Np
MKB	1.91, 2.13, 2.36, 2.63, 2.86 and 3.08 Np

The line equalizer attenuation at 252 KHz for all types of cables	0.1 Np

Note: The line amplifiers cannot be used without the line equalizers.

The AGC System:

In the NUP amplifiers (ground referenced AGC)	Thermo-electric, frequency dependent
In the OUP amplifiers (AGC based on control frequencies)	Electro-thermomechanical, two- and three-frequency
In the primary group receive channel	Electro-thermomechanical, single frequency

Control Frequencies:	Slope	16 KHz
	Curvilinear	112 KHz
	Flat	248 KHz
	In the receive channel for the primary groups	84.14 KHz
	The same, for the secondary group	411.86 KHz

The nominal control frequency levels at the zero level point

Line	-2.0 Np
Group	-2.9 Np

The amplifiers with AGC are positioned as follows:

With ground referenced AGC	At each NUP
With two-frequency AGC (at OUP's)	Every 250 - 300 km
With three-frequency AGC (at OP's and OUP's)	Every 500 - 600 km

The range control limits of the amplifiers with AGC:

-- For NUP amplifiers with ground referenced AGC (when the ground temperature varies from -2 to +18° C, from -10 to +10° C and from +10 to +30° C:

MKSB [cable] at frequencies of:	12 KHz	0.13 Np
	252 KHz	0.25 Np
MKB at frequencies of 12 KHz and 252 KHz		0.09 Np

Notes: 1. In the project planning, it is necessary to take into account the inaccuracy of ground referenced AGC equalization on OUP-OUP sections amounting to $\pm$ 0.3 Np.

2. The length of the connecting cable from the terminal unit of the NUP to the ground referenced AGC: should not exceed 14 m when the ground temperature fluctuates within limits of -2 to +18° C; 10 m for a higher or lower ground temperature where the number of NUP's is greater than four, and 14 m at any temperature where the number of NUP's runs up to four.

3. The ground referenced AGC cable should be balanced, the values of the crosstalk attenuation between the circuits should be no less

than: 9.5 nepers for 90%, 9.8 nepers for 65% and 9.0 nepers for 100% of the circuits.

— For amplifiers with two-frequency AGC:

Flat control (248 KHz)	$\pm$ 0.5 Np
Slope control (12 KHz)	$\pm$ 0.4 Np

— For amplifiers with three-frequency AGC:

Flat control (248 KHz)	$\pm$ 0.5 Np
Slope control (12 KHz)	$\pm$ 0.5 Np
Curvilinear control (80 KHz)	$\pm$ 0.4 Np

— For the receive channel for the primary and secondary groups (84.14 and 411.86 KHz) $\pm$ 0.4 Np

Note: In the project planning, the imprecision in the AGC control based on the line control frequencies amounting to $\pm$ 0.05 Np is to be taken into account (a reduction in the level over the entire route by 0.05 Np at the maximum ground temperature).

Phantom lines are installed as follows at the input to the HF channels:

NUP, OUP and OP		Every 3 km, 6 km, 3 + 6 km
The phantom line attenuation at:	252 KHz	0.86 Np, 1.72 Np, 0.56 Np respectively
	12 KHz	0.25 Np, 0.5 Np and 0.75 respectively

Note: A provision is made in phantom lines for the option of switching out the 0.4 Np pad.

The attenuation of trunk equalizers at 252 KHz	0.3 Np
Trunk equalizers are installed at NUP's every	60 - 80 km

Note: The ordering of a variable trunk equalizer for the alignment of a channel is based on a figure of no less than two for each OUP, and is specified in a special order.

The cosine corrective network, intended for the equalization of temperature distortions, is installed at the input to an amplifier with three-frequency AGC, and OUP and OP's, and corrects the amplitude-frequency response with a nonuniformity of	$\pm$ 0.3 Np
The ringup system using the HF channels	Voice frequency ringing at 2,100 Hz.

The number of service links provided for servicing the trunk:

Operator trunk service communications link, MSS	1
Station-to-station operator service communications link, PSS	2
Sectional operator service communications link, USS	1

The number of NUP's which can be remotely power between two power supply OUP's, working from the maximum permissible remote power supply voltage in the following circuit configurations:

"wire-wire"	6
"wire-ground"	12

(In individual cases, when specially justified, it is permissible to increase the number of NUP's up to 14. In this case, the constantly induced e.m.f. from an alternating current electrified railroad should be no more than 75 volts on each repeater section, and one internal choke in each protective unit should be cut out at all NUP's.)

Notes: 1. Remote power is provided via the quads;
2. The voltage drop across the working ground of the last NUP due to the overall remote supply current should be made equal to 36 - 12 v where necessary.

The permissible DC induced voltage, which can be compensated by the PK-70/0.3-2 compensator — ± 70 volts

Notes: 1. Where DC induced voltages of up to ±35 volts are present in the half-sections of the remote power supply, capacitors are not obligatory.
2. Where DC induced voltages of up to ±70 volts are present, for a half-section the number of NUP's between the supply OUP's is determined from the design calculations (for the case of a "wire--ground" remote power circuit configuration).
3. In the presence of DC induced voltages greater than ±70 volts, a "wire-wire" remote power circuit configuration is adopted.

The permissible voltage (longitudinal e.m.f.) due to the influence of an alternating curren electrified railroad and electrical power transmission lines on a repeater section:

Long term:

-- When one protective ground unit is inserted in the remote power circuit at NUP's and OUP's	200 volts eff.
-- When one (internal) choke of the protective unit is switched out at NUP's and OUP's	75 volts eff.

Short term:

The grounding device:

-- For NUP's when powered with the following circuit configurations:

"wire-ground":	
NUP's within remote power half-sections	One ground
NUP's at the end of the remote power half-section	Two grounds, one working, one protective ground
"wire-wire"	One ground, working, (or protective)

Notes: 1. The resistance of each ground should be in accordance with GOST 464-68.

2. The ground is made in accordance with "Rekomendatsii po voprosu oborudovaniya zazemleniy i zazemlyayushchikh provodok LATs i NUP" ["Recommendations on the Question of Ground Equipment and Grounding Wires of Line Equipment Shops and Unattended Repeaters"], ("Svyaz'" Publishers, 1969).

-- For OUP's and OP's	Three grounds: a working, and two metering grounds.

Climatic Operational Conditions

Attended Stations and the Line Channel of Terminal Stations. At temperatures of from +5 to +40° C and a relative humidity of up to 85% at temperatures of up to 30° C.

Conversion Equipment. At temperatures of from +10 to +40° C and relative humidities of up to 85% at temperatures of up to +25° C.

Unattended Stations. At temperatures of from -10 to +35° C, and for a relative humidity of 80%. The option of SPUN rack operation is permitted for temperature fluctuations of from -40 up to +50° C, and an increase in the humidity up to 98%.

Electrical Power Supply

Voltages:

-- Terminal and attended intermediate stations:	
Main circuits	21.2 volts ± 3%
Signaling	24 volts ± 10%
AC mains	220 volts
-- Unattended repeater stations:	
Remote power, fed into the line (maximum) at the terminals of the equipment being powered	475 volts
Without the protective devices	36 volts
The same, with the protective devices	48 volts

Current and Power Consumption

Equipment	21.2 v amps	24 volts amps	220 volts VA
SGP (with the full complement) for four systems:			
Main circuits	5.0	-	-
Signaling	-	2.0	-
SLUK OP for two systems:			
Main circuits	1.1	-	-
Signaling	-	3.5	-
The same, for four systems:			
Main circuits	2.2	-	-
Signaling	-	5.6	-

Current and Power Consumption, continued

Equipment	21.2 v amps	24 volts amps	220 volts VA
SKCh:			
Main circuits	1.6	-	-
Signaling	-	1.8	-
SKCh when powered from the AC mains	-	-	110
SSS-7 or SSS-8	-	See Section 11	-
UKM control panel	-	-	70
SUGO I-1:			
Main circuits, main power	8.75	-	-
Main circuits, standby power	8.75	-	-
Signaling	-	1.67	-
Oscilloscope	-	-	25
SIP-60:			
Main circuits	1.0	-	-
Signaling	-	0.4	-
STV-DS-60:			
Main circuits	3.2	-	-
The same, when 50% of the ring circuits operate	5.8	-	-
Signaling	-	0.4	-
SDP K-60p with the complete complement and maximum load	72	-	-
TM OUP equipment for 14 NUP's	-	3.0	-
SLUK OUP-2 for two systems:			
Main circuits	1.2	-	-
Signaling	-	5.5	-
The Same, for four systems:			
Main circuits	2.4	-	-
Signaling	-	9.5	-
SLUK OUP-3 for two systems:			
Main circuits	1.5	-	-
Signaling	-	5.7	-
SPUN K-60 for one system	0.2 amps (remote power) at voltages of 36 - 48 volts.		

Equipment Complement

Terminal Station

a) SVKO K-60p Cable Input Equipment: A rack for two four-quad, high and low level cables, intended for connecting in and servicing cables with a capacity of 4 x 4, multiplexed up to 280 KHz with the K-60p equipment.

The rack provides for the following: Bringing in and fanning out two long distance 4 x 4 x 1.2 cables; organizing high frequency and phantom circuits; transmitting remote power at voltages up to 500 volts via a superphantom circuit; protecting service personnel and station equipment against dangerous voltages; making check measurements when substituting

individual pairs of a cable; galvanically isolating from station devices with a reserve in the electrical strength, amounting to no less than 2,000 volts eff. at 50 Hz AC for the line windings of high and low frequency transformers. One SVKO K-60p rack is installed at an OP.

Note: The use of the VKS K-60 racks is permitted only under the condition that the R-4 dischargers are inserted in parallel with the station windings of the line and phantom transformers.

b) The SDP K-60p Remote Power Rack: A rack for eight remote power circuits, intended for the conversion of a regulated 21.2 v ± 3% DC to DC voltages up to 500 volts; and for remote power of the NUP K-60p, as well as switching and protection of the remote power circuits.

The rack provides for the following: the remote power for six to seven NUP K-60p's via eight remote power circuits when working via a "wire--ground" circuit, and one to three NUP's via four remote power circuits when working via a "wire-wire" circuit; the current level at the output of each remote power circuit is 0.2 amps ± 10% at voltages of from 100 to 475 volts ± 5% (the voltage is adjusted continuously as well as in steps of 50 volts each); automatic switching of the remote power voltage for the case of a circuit break with current overloads of 20%.

The plant produces a rack based on the design calculation for the remote power for a "wire-ground" circuit, i.e., one converter is provided for each remote power circuit.

On trunks with a four-quad cable, one rack is installed at an OP and two in the OUP's. For a seven quad cable, the number of racks is doubled.

A provision is made in the SDP racks for the option of powering all auxiliary circuits from a voltage of 24 volts ± 10%.

c) The SLUK-OP K-60p rack of line amplifiers and corrective networks: a rack for two or four systems, intended for amplifying the 12 - 280 KHz line spectrum and compensating for the attenuation of the cable section adjacent to the OP.

The rack can also be employed for terminal and junction stations of a radio relay link, as well as OUP's when isolating 60-channel groups from the K-300, K-1920 systems, etc.

Three types of SLUK-OP racks are manufactured for MKSB, MKB and MKPV cables.

Each type of rack is manufactured for two systems; in order to increase the equipment complement up to four systems, KLUK-OP sets of panels of line amplifiers and corrective networks for two systems are installed (respectively: KLUK-OP for MKSB, KLUK-OP for MKB and KLUK-OP for MKPV).

d) The SKCh K-60p control frequency rack: a rack for eight systems, intended for deriving the 16, 112 and 248 KHz line control frequencies for feeding two SLU-OP racks (eight systems). The SKCh K-60p is installed at points where SUGO-I is lacking (or is located at a distance).

In the equipment, 100% backup of all main assemblies is provided, with automatic switching from a main to a standby set when the level changes by $\pm$ 0.04 - 0.06 Np.

e) The SUGO-I-1 Generator Equipment: A rack for eight systems (see Section 6).

Note: Where necessary, the SUGO-1-2 rack can be used (without the equipment for deriving individual carriers).

f) SGP K-60p Rack of Group Converters: A rack of two or four systems, intended for converting the five standard 12-channel groups in the transmit channel at the working frequency spectrum of 60 - 108 Khz to the line frequency spectrum of 12 - 252 KHz, and the corresponding back conversion in the receive channel. A provision is made for the option of deriving three variants of the line frequency spectrum. The first two variants correspond to the direct conversion, the main and inverse frequency spectra, adopted in the K-60 and K-60p systems, while the third variant is employed for the transmission of through-working 60-channel groups from the K-300, K-1920 and R-600 systems, or, vice versa, via balanced junction lines.

A provision is made in the rack for the option of separate utilization of the conversion equipment for the primary and secondary groups, for which all through-working points of the groups are brought out to input terminal blocks, and break jacks are provided at the input and output of the primary and secondary conversion equipment. The SGP racks are manufactured as follows: the SGP-1 for four systems and SGP-2 for two systems. Additionally, two variants of panel sets are manufactured for primary and secondary conversion: the KPP is a set of primary conversion panels and the KPVG-0 is a set of secondary group (zero) panels. Located in the SGP-1 rack are four sets of primary conversion panels (KPP) and four secondary conversion sets (KPVG-0), while in the SGP-2 rack there are two KPP sets and two KPVG-0 sets. Each SGP rack is designed for filling with a maximum of up to four systems.

The number of standby KPP and KPVG-0 sets, as well as standby control channel receivers, PKK-84.14 and PKK-411.86, is specified when ordering.

g) Individual Conversion Equipment: The SIP-60 is a rack for 60 channels and the STV-DS-60 rack is a rack for 60 channels (see Section 7).

Note: Supplied on special order for the SIP-60 rack is the PIB instrument for testing the blocks of individual converters.

h) The Standardized Switching-Callup Service Communications Equipment (UKVSS) SSS-7 or SSS-8: A rack (see Section 11).

i) Remote Monitor Equipment: An instrument for all systems.

j) Instrument for aligning the cosine corrective networks: an instrument for all systems.

k) The remote control equipment is in the developmental stage.

l) The SKP-1 Primary Group Switching Rack: A cabinet type rack, designed for 50 primary groups (see Section 1).

Note: The SKP-1 is installed in line equipment shops, where no less than 10 primary groups are planned in the future.

m) The STPG Primary Group Through-Working Rack (Section 8).

The Attended Intermediate Station

a) Cable Entrance Equipment:

The SVKO K-60p for connecting in the high and low level cables is a rack for two 4 x 4 cables.

The SKVO K-60p is the same, for connecting in low level cables and is a rack for two 4 x 4 cables.

Note: The use of VKS K-60 racks is permitted only under the condition that the R-4 dischargers are inserted in parallel with the station windings of the line and phantom transformers.

b) The SLUK-OUP-2 Rack of Line Amplifiers and Corrective Networks with Two-Frequency AGC: A rack for two or four systems, intended for the fol lowing: compensating for the attenuation introduced by a cable section adjacent to the OUP in a frequency range of 12 - 280 KHz; correction of the overall amplitude-frequency distortions, which change with time.

   The SLUK-OUP-2 rack is manufactured in three types for two systems for MKSB, MKB and MKPV cables. Each type of rack is designed for a maximum load of up to four systems.

   The KLUK OUP-2 set for filling out the equipment complement of the SLUK OUP-2 are likewise manufactured as three types for the following cables: MKSB, MKB and MKPV.

c) The SLUK OUP-3 rack of line amplifiers and corrective networks with three frequency AGC: a rack for two systems, intended for the same purposes as the SLUK-OUP-2 rack, and additionally installed in it are cosine corrective network panels with amplifiers and a PKK-112 [KHz] control channel receiver.

   Three types of SLUK OUP-3 racks are manufactured for MKSB, MKB and MKPV cables.

d) The SDP K-60p Remote Power Rack: Installed at OUP's are two racks, each for eight remote power supply circuits.

e) The Standardized Switching-Callup Service Communications Equipment (UKVSS) SSS-7 or SSS-8: One rack.

f) The instrument for aligning the cosine corrective networks is an instrument for all systems.

g) The remote control equipment is in the developmental stage.

h) The remote monitor equipment is an instrument for all systems.

Note: At the present time, the K-60p equipment is supplied as a complete package for terminal and intermediate stations.

The Unattended Intermediate Stations

a) VKSh-1 Cable Entrance Equipment:

The cable entrance cabinet for the connecting in of the high and low level cables is for four cables with a capacity of 4 x 4. The VKSh-1 cabinet contains the following: a metal cabinet, four moisture tight boxes of the BVM-1 12 x 2 type with two PE-6 shielded terminal strips each; four connecting blocks with tapers (gas tight couplings); two branching couplings for bringing cables from the temperature sensor block into the NUP; a sensor for the presence of water in the NUP housing; and a set of spare parts (lacing, protective covers, a two-pair plug and a voltage indicator).

b) The SPUN K-60p Rack of Unattended Intermediate Amplifiers: A rack for two or four systems, intended for compensating for the attenuation introduced by a cable section adjacent to an NUP in a frequency range of 12 - 280 KHz.

The SPUN K-60p is supplied in the following equipment complements: SPUN-1-SK, SPUN-2-SK: Racks for two systems for MKSB cables; SPUN-1-BK, SPUN-2-BK: Racks for two systems for MKB cable.

Notes: 1. The capacity of each rack can be increased up to four systems by means of installing sets of panels of two systems each.
2. Being produced at the present time are modernized SPUN-M racks.

Installed in the SPUN-1 rack, in contrast to the SPUN-2, is a remote control panel, TM, and a monitor generator panel, GK. Included in the equipment complement of the SPUN rack are: the block of temperature transducers, a variable trunk equalizer (the number is stipulated when ordering), a phantom line, a fixed trunk equalizer and D-280 filter (they are ordered individually taking into account the number of them supplied with the equipment); brackets for mounting the SPUN rack (stipulated when ordering for the case of SPUN installation in a vertical temperature controlled chamber).

KP-SK is a set of panels for two systems for MKSB cable; KP-BK is a set of panels for two systems for MKB cable.

c) Portable Telephone Handset (the service communications amplifiers are included in the complement of the SPUN K-60p).

d) The Remote Control and Remote Monitoring Unit is included in the complement of the SPUN K-60p.

Construction:

Terminal and Intermediate Stations

The SVKO, SDP, SLUK OP, SKCh, SGP, SLUK OUP-2 and SLUK OUP-3 racks are made in the form of frames of U-section steel with chassis mounted on them for holding the individual blocks. The racks are designed for servicing on one side. The rack dimensions are 2,600 x 650 x 250 mm.

Unattended Intermediate Stations

VKSh-1. A metal cabinet with a door. Housed inside the cabinet are moisture proof boxes, while secured in the upper part are terminal blocks with

gas tight couplings, and grounding bolts are also located there. In the bottom of the cabinet there is a hole for mounting and fastening the sensor for the presence of water in the NUP. The dimensions are 1,685 x 650 x 300 mm.

SPUN K-60p. A metal, moisture proofed cabinet with the units mounted on one side. The cabinet is closed by a door having a seal. The dimensions are: 1,730 x 655 x 276 mm. The SPUN-M of the K-60p equipment has dimensions of 1,785 x 568 x 290 mm.

Weight and Cost

Equipment	Weight, kg	Price, rubles
SVKO	350	2,966
SDP	400	4,032
SLUK OP for two systems	300	7,589
KLUK OP for two systems	50	-
SKCh for eight systems	350	3,720
SGP-1 for four systems	400	12,400
SGP-2 for two systems	350	7,440
SLUK OUP-2	300	6,528
KLUK OUP-2	50	-
SLUK OUP-3	350	9.145
VKSh-1	132	660
SPUN-1-SK or BK	310	4,300
SPUN-2-SK or BK	310	4,000
KP-SK or BK	35	740
SPUN-M SK or BK	210	-

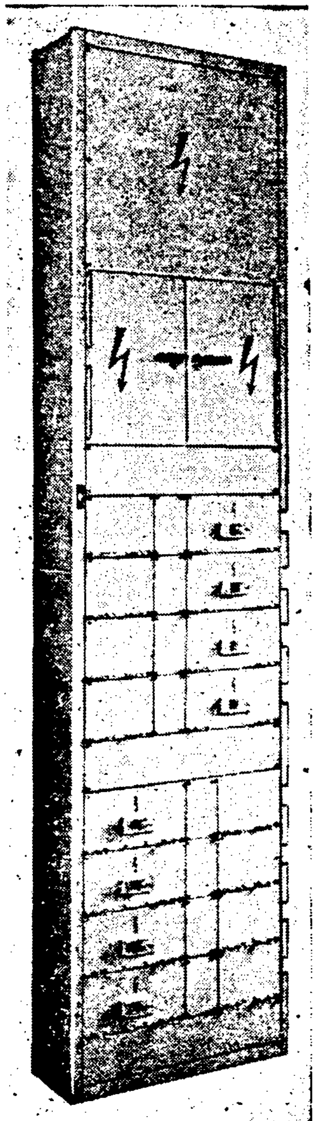


Figure 4.8.1. Exterior view of the SKVO cable input equipment rack of the K-60p equipment.

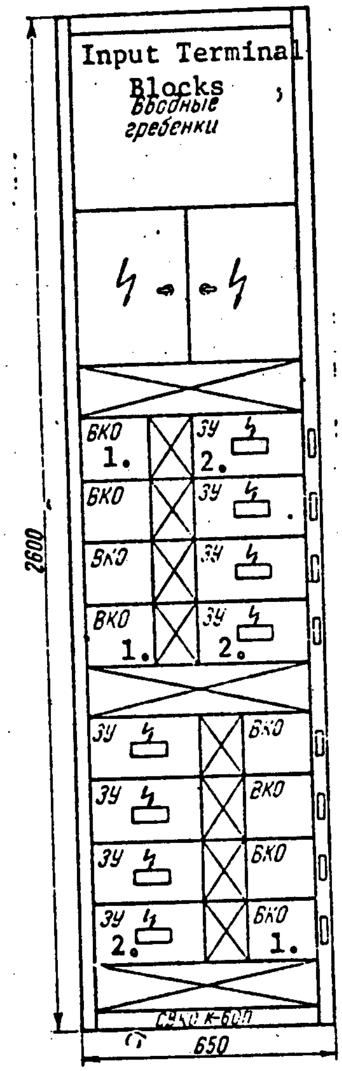


Figure 4.8.2. The placement of the equipment in the SVKO cable input equipment rack of the K-60p equipment.

Key: 1. VKO [cable entrance equipment];
2. ZU [protective (grounding) unit].

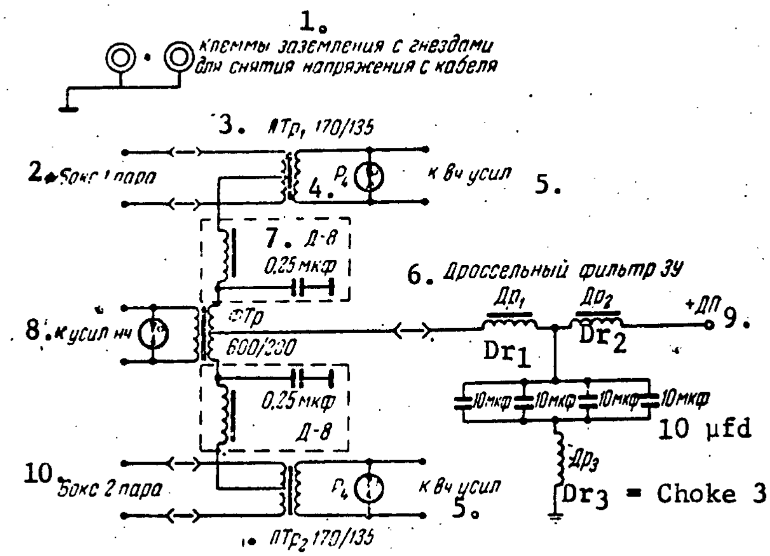


Figure 4.8.3. Schematic of the SVKO cable input equipment of the K-60p equipment.

Key: 1. Ground terminals with jacks for picking off the voltage from the cable;
2. Box of pair 1;
3. Line transformer 1, 170/135 [ohms];
4. Discharger R4;
5. To the HF amplifier;
6. Choke filter of the protective unit;
7. D-8 filter;
8. To the low frequency amplifier;
9. DP [remote power];
10. Box of pair 2;

ФТр = Phantom transformer.

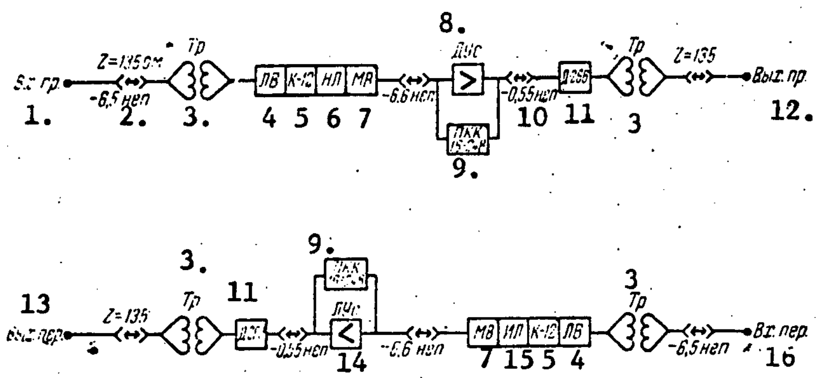


Figure 4.8.4. Block diagram of the SLUK OUP-2 rack of line amplifiers and corrective networks of the K-60p equipment.

Key: 1. Receive input;
2. -6.5 Np, Z = 135 ohms;
3. Transformer;
4. Line equalizer;
5. K-12 filter;

[Key to Figure 4.8.4, continued]:

6. NL [possible typographical error for IL - phantom line];
7. Trunk equalizer;
8. DUs [possible typographical error for LUs - line amplifier];
9. 16 - 248 KHz control channel receiver;
10. -0.55 nepers;
11. D-268 filter;
12. Receive output;
13. Transmit output;
14. LUs [line amplifier];
15. IL [phantom line];
16. Transmit input.

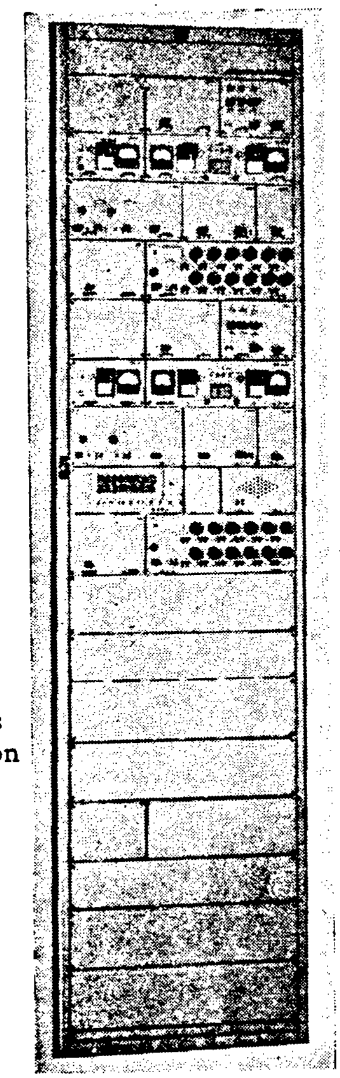


Figure 4.8.5. Exterior view of the SLUK OP rack of line amplifiers and equalizers of a terminal station of the K-60p equipment.

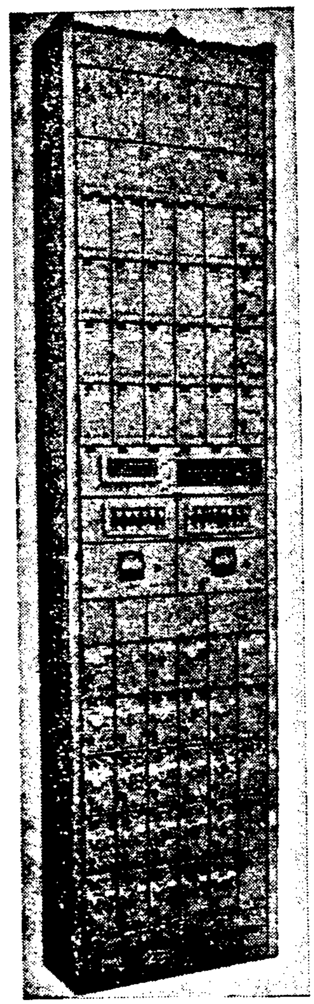


Figure 4.8.6. Exterior view of the SGP group conversion rack of the K-60 equipment.

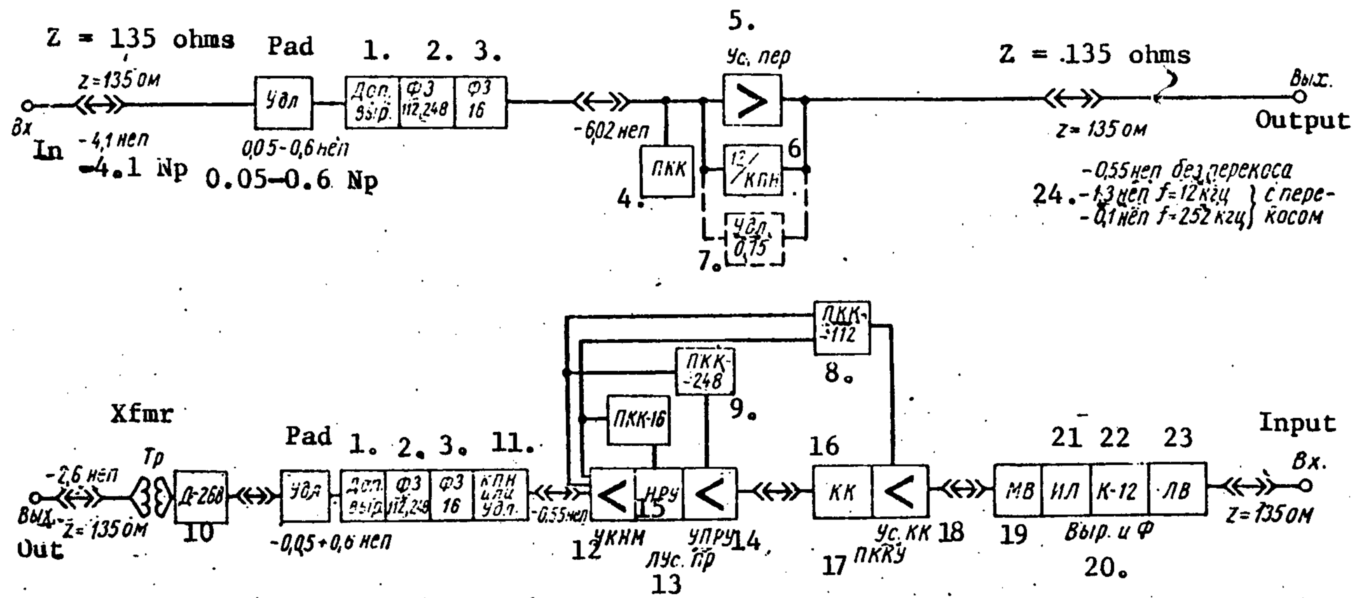


Рис. IV.8.7. Блок-схема стойки линейных усилителей и корректоров оконечного пункта (СЛУК ОП) аппаратуры К-60п

Figure 4.8.7. Block diagram of the rack of line amplifiers and corrective networks of a terminal point (SLUK OP) of the K-60p equipment.

Key:
1. Supplemental equalizer;
2. 112, 248 KHz suppression filter;
3. 16 KHz suppression filter;
4. PKK [control channel receiver];
5. Transmit amplifier;
6. KPN [either a fixed or variable slope network];
7. 0.75 Np pad;
8. 112 KHz control channel receiver;
9. 248 KHz control channel receiver;
10. D-268 filter;
11. KPN or pad;
12. UKNM [expansion unknown];
13. Receive line amplifier;
14. UPRU [expansion unknown];
15. NRU [?slope type gain control?]
16. KK [either cosine or corrective network];
17. PKKU [expansion unknown];
18. Corrective network amplifier;
19. MV [trunk equalizer];
20. Equalizer and filter;
21. Phantom line;
22. K-12 filter;
23. Line equalizer;
24. -0.55 Np without skewing [of the frequency response];
    -1.3 Np at f = 12 KHz and
    -0.1 Np at f = 252 KHz, with skewing.

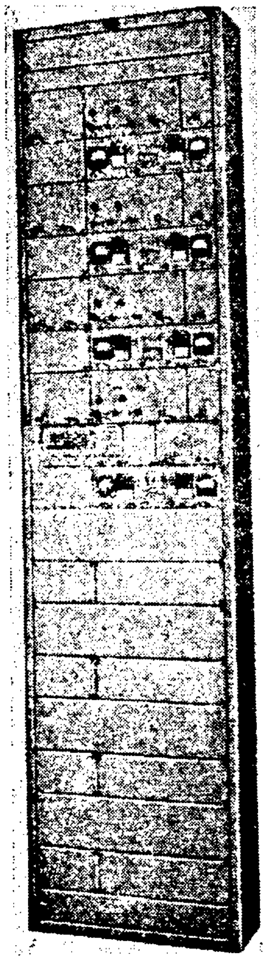


Figure 4.8.8. Exterior view of the SLUK OUP-2 rack of line amplifiers and corrective networks of an attended repeater station with two-frequency AGC of the K-60p equipment.

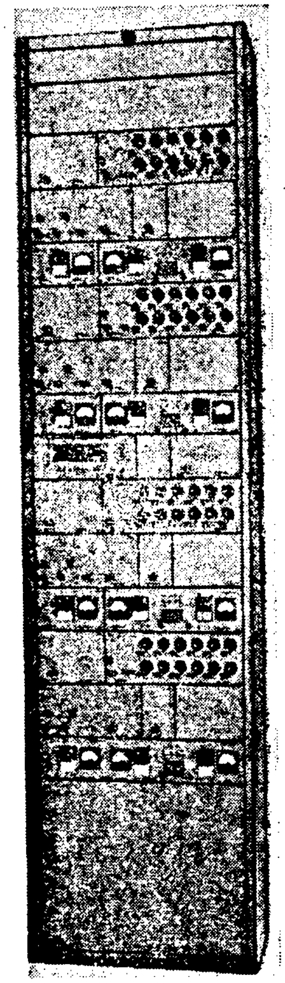


Figure 4.8.9. Exterior view of the SLUK OUP-2 rack of line amplifiers and corrective networks of an attended repeater station with three-frequency AGC of the K-60p equipment.

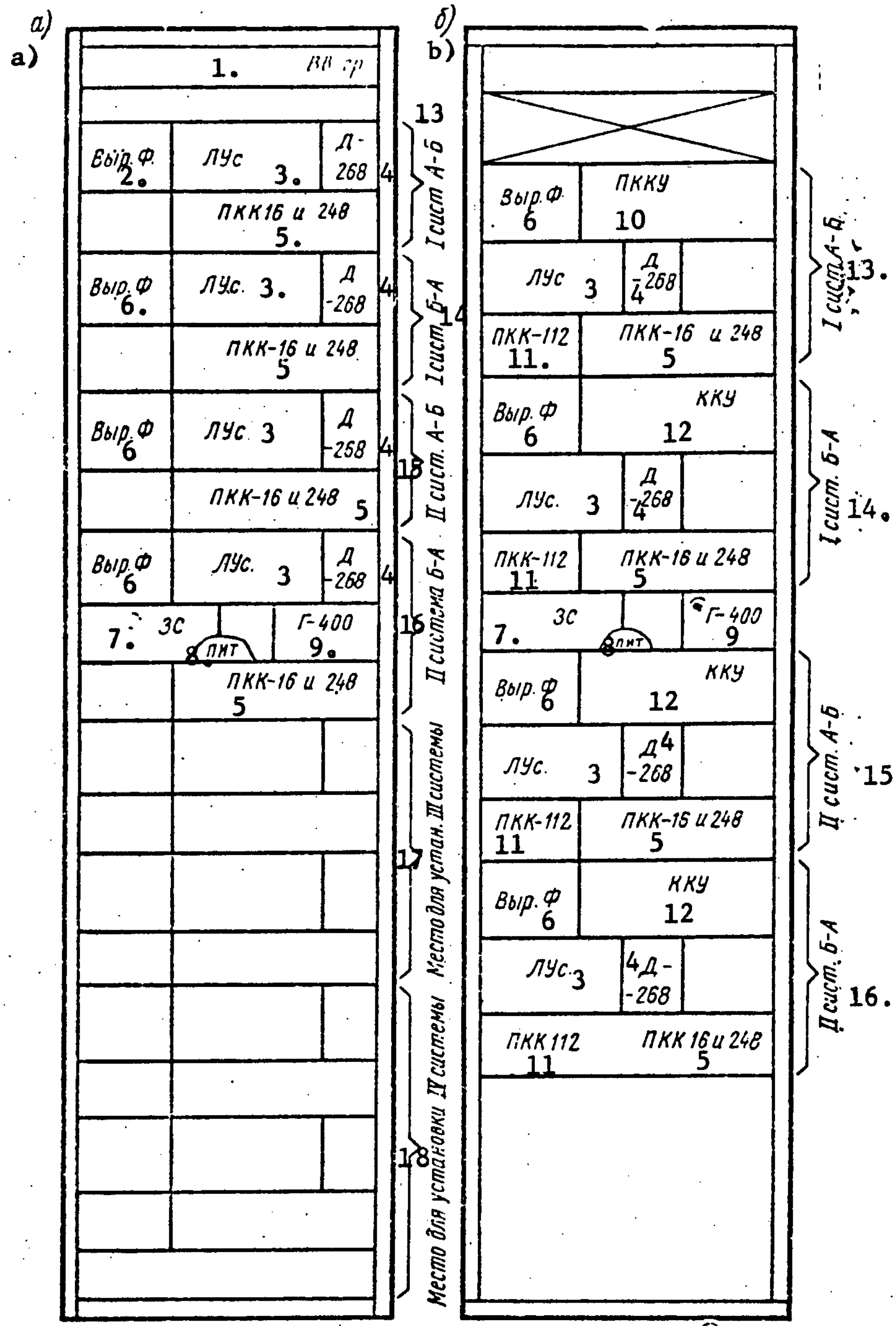


Figure 4.8.10. The placement of the equipment in the rack of line amplifiers and corrective networks for two systems of the K-60p equipment:
a) The SLUK OUP-2; b) The SLUK OUP-3.

Key: 1. Input terminal blocks;
2. Equalizer-filter;

[Key to Figure 4.8.10, continued]:

3. Line amplifier;
4. D-268 filter;
5. 16 KHz and 248 KHz control channel receiver;
6. Equalizer-filter;
7. Protection and signaling panel;
8. PIT [power supply panel?];
9. 400 Hz generator;
10. PKKU [?control channel receiver control panel?];
11. 112 KHz control channel receiver;
12. KKU [expansion unknown];
13. A - B System 1;
14. B - A System 1;
15. A - B System 2;
16. B - A System 2;
17. Location for the installation of System 3;
18. Location for the installation of System 4.

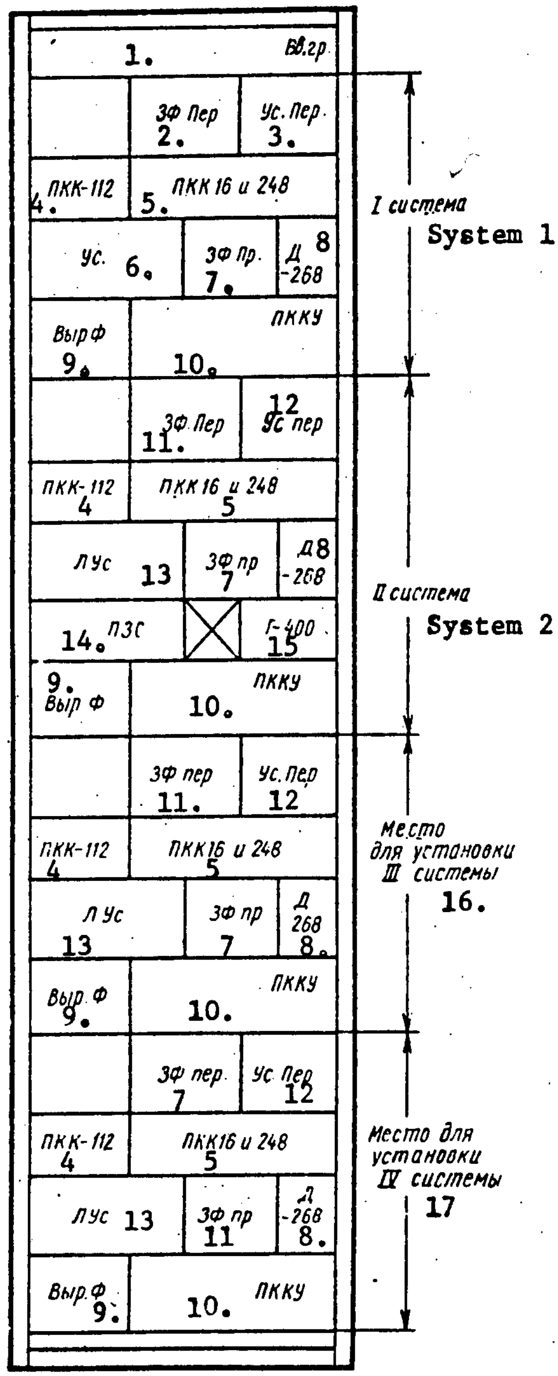


Figure 4.8.11. The placement of the equipment in the SLUK OP rack of line amplifiers and corrective networks of the K-60p equipment.

Key:

1. Input terminal blocks;
2. Transmit suppression filter;
3. Transmit amplifier;
4. 112 KHz control channel receiver;
5. 16 and 248 KHz control chann receiver;
6. Amplifier;
7. Receive suppression filter;
8. D-268 filter;
9. Equalizer-filter;
10. PKKU [expansion unknown];
11. Transmit suppression filter;
12. Transmit amplifier;
13. Line amplifier;
14. Protection and signaling panel;
15. 400 Hz generator;
16. Location for the installation of System 3;
17. Location for the installation of System 4.

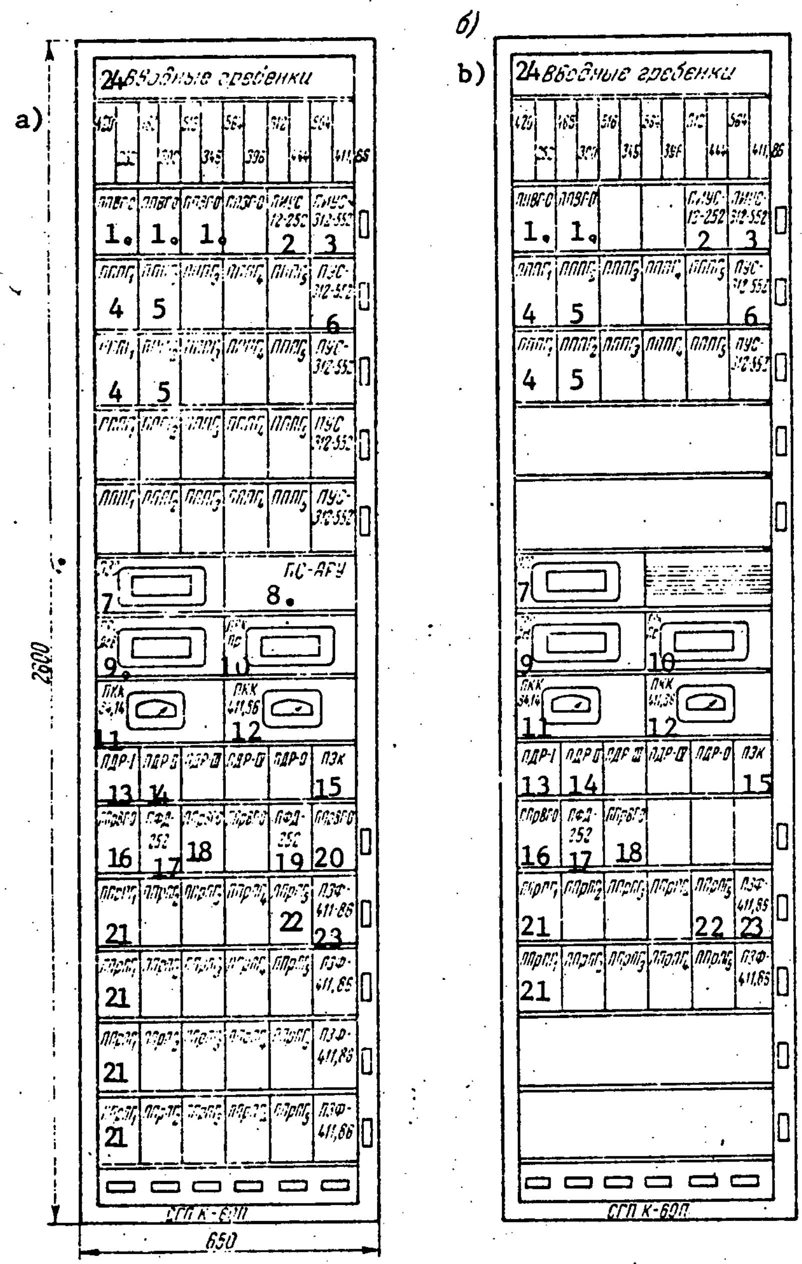


Figure 4.8.12. The placement of the equipment in the SGP group conversion rack of the K-60p equipment:
a) The SGP-1 for four systems; b) The SGP-2 for two systems.

Key: 1. PPVG-0 [secondary group conversion panel 0];
2. PIUS-12-252 [12 - 252 KHz crosstalk test unit];
3. 312 - 552 KHz crosstalk test unit;
4. $PPPG_1$ [primary group conversion panel 1];
5. $PPPG_2$ [primary group conversion panel 2];

[Key to Figure 4.8.12, continued]:

6. PUS 312 - 552 [?312 - 552 KHz primary amplifier?];
7. PZS [signaling and fuse panel];
8. PS-ARU [?automatic gain control signaling panel?];
9. PRK lev [left side PRK (expansion unknown)];
10. Right side PRK;
11. 84.14 KHz control channel receiver;
12. 411.86 KHz control channel receiver;
13. PDR-I [expansion unknown];
14. PDR-II;
15. PEK [expansion unknown];
16. PPrVG-0 [secondary group conversion panel 0 for receive];
17. PFD-252 [?252 KHz D-252 bandpass filter?];
18. PPrVG-0 ;
19. PFD-252;
20. PPrVG-0;
21. $PPrPG_1$ [primary group 1 conversion panel for receive];
22. Primary group 5 conversion panel for receive;
23. PZF-411.86 [?411.86 KHz suppression filter panel?];
24. Input terminal blocks.

[Key to Figure 4.8.13, page 348]:

1. RM444 (612) [444 KHz (or 612 KHz) power distributor];
2. -4.5 Np/135 ohms;
3. To the SIO [individual conversion equipment rack];
4. RM-420 (252) [420 KHz (or 252 KHz) power distributor];
5. RM-468 (300);
6. RM-516 (348);
7. RM-564 (396);
8. Transformer;
9. D-125 filter;
10. 0.2 Np pad;
11. Group converter;
12. 0.35 - 0.5 Np pad;
13. PPPG-1 [primary group conversion panel 1, transmit];
14. PFPG-1 [group conversion bandpass filter 1];
15. KON [expansion unknown];
16. Carrier frequency = 468 KHz (or 300 KHz);
17. Carrier frequency = 516 KHz (or 348 KHz);
18. Carrier frequency = 564 KHz (or 396 KHz);
19. Carrier frequency = 444 KHz (or 612 KHz);
20. BPRPG per [unknown type of transmit unit];
21. ZF 411.86 [411.86 KHz suppression filter];
22. PUS 312-552 [?312 - 552 KHz transmit amplifier?];
23. Pad;
24. PPG [primary group conversion] output, -4.1 Np, 75 ohms;
25. 312 - 552 KHz PVG [secondary group conversion] input;

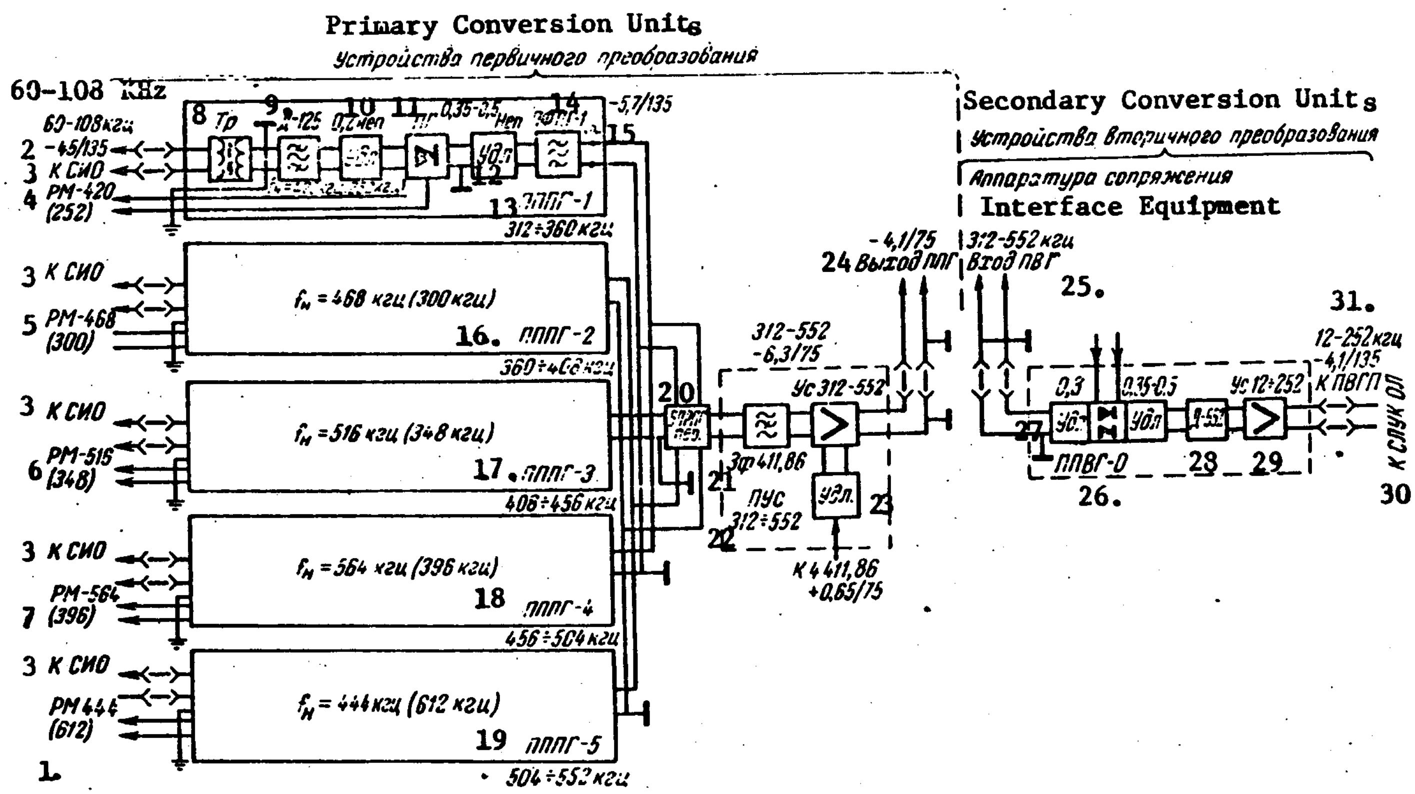


Рис. IV.8.13. Блок-схема тракта передачи СГП аппаратуры К-60п

Figure 4.8.13. Block diagram of the transmit channel of the SGP [group conversion rack] of the K-60p equipment.

[Key continued from preceding page]:

26. PPVG-0 [secondary group conversion panel 0, transmit];
27. 0.3 Np pad;
28. D-552 filter;
29. 12 - 252 KHz amplifier;
30. To the SLUK OP;
31. 12 - 252 KHz, -4.1 Np/135 ohms, to the PVGP.

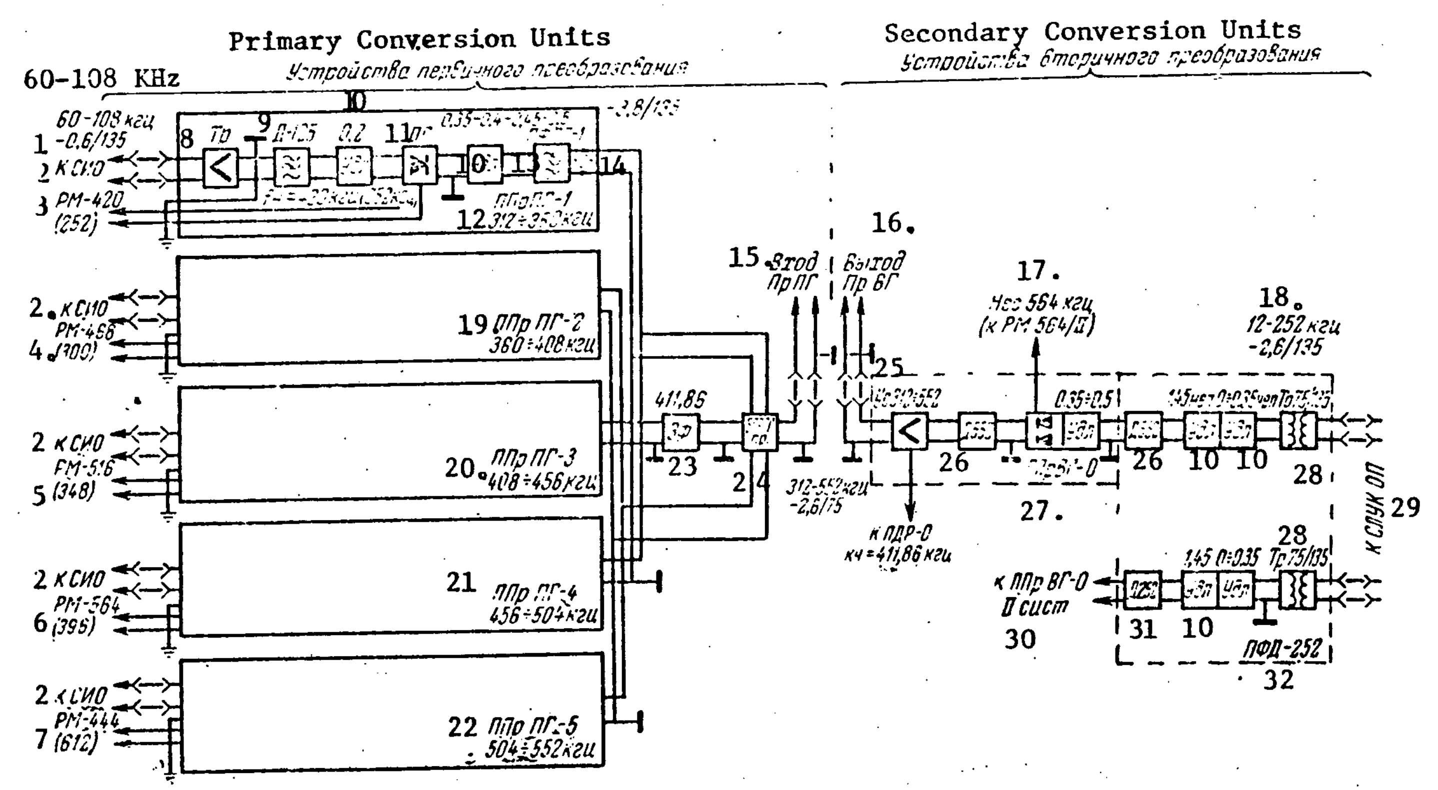


Figure 4.8.14. Block diagram of the receive channel of the SGP [group conversion rack] of the K-60p equipment.

Key: 1. -0.6 Np/135 ohms;
2. To the SIO [individual conversion equipment rack];
3. RM-420 (252) [420 KHz (or 252 KHz) power distributor];
4. RM-468 (300) [468 KHz (or 300 KHz) power distributor];
5. RM-516 (348);
6. RM-564 (396);
7. RM-444 (612);
8. Transformer;
9. D-125 filter;

[Key to Figure 4.8.14, continued]:

10. Pad;
11. Group converter
12. PPrPG-1 [primary group conversion receive panel 1], 312 - 360 KHz;
13. PFPG-1 [primary group 1 passband filter];
14. KON [expansion unknown];
15. Primary group receive input;
16. Secondary group receive output;
17. 564 KHz carrier (to the 564 KHz power distributor II);
18. 12 - 252 KHz, -2.6 Np/135 ohms;
19. 360 - 408 KHz primary group conversion receive panel 2;
20. 408 - 456 KHz primary group conversion receive panel 3;
21. 456 - 504 KHz primary group conversion receive panel 4;
22. 504 - 552 KHz primary group conversion receive panel 5;
23. 411.86 KHz suppression filter;
24. BPRPG pr. [unknown type of receive unit];
25. 312 - 552 KHz amplifier;
26. D-552 filter;
27. PPr VG-0 [secondary group 0 conversion, receive];
28. 75/135 ohm transformer;
29. To the SLUK OP;
30. To the secondary group 0 conversion receive panel of system II;
31. D-252 filter;
32. PFD-252 [?252 KHz D-252 bandpass filter?].

[Key to Figure 4.8.15, page 351]:

1. Control frequency power distributors;
2. Main 248 KHz control frequency receiver;
3. PChKCh-248 [unknown type of 248 KHz control frequency receive unit];
4. 248 KHz standby control frequency receiver;
5. Main 16 KHz receiver;
6. PUKCh-16;
7. PKU-16 rez. [standby 16 KHz monitor panel];
8. PKCh-112 osn [main 112 KHz control channel receiver];
9. PUKCh 112;
10. PKCh-111 rez [standby 111 (sic) KHz control channel receiver];
11. PGG-8 osn [?main 8 KHz harmonic generator panel?];
12. PGG-8 rez [?standby 8 KHz harmonic generator panel?];
13. Fuse and signaling panel;
14. PZG-8 osn [main PZG-8 (expansion unknown)];
15. Oscilloscope;
16. PZG-8 standby;
17. PV [expansion unknown] rectifier.

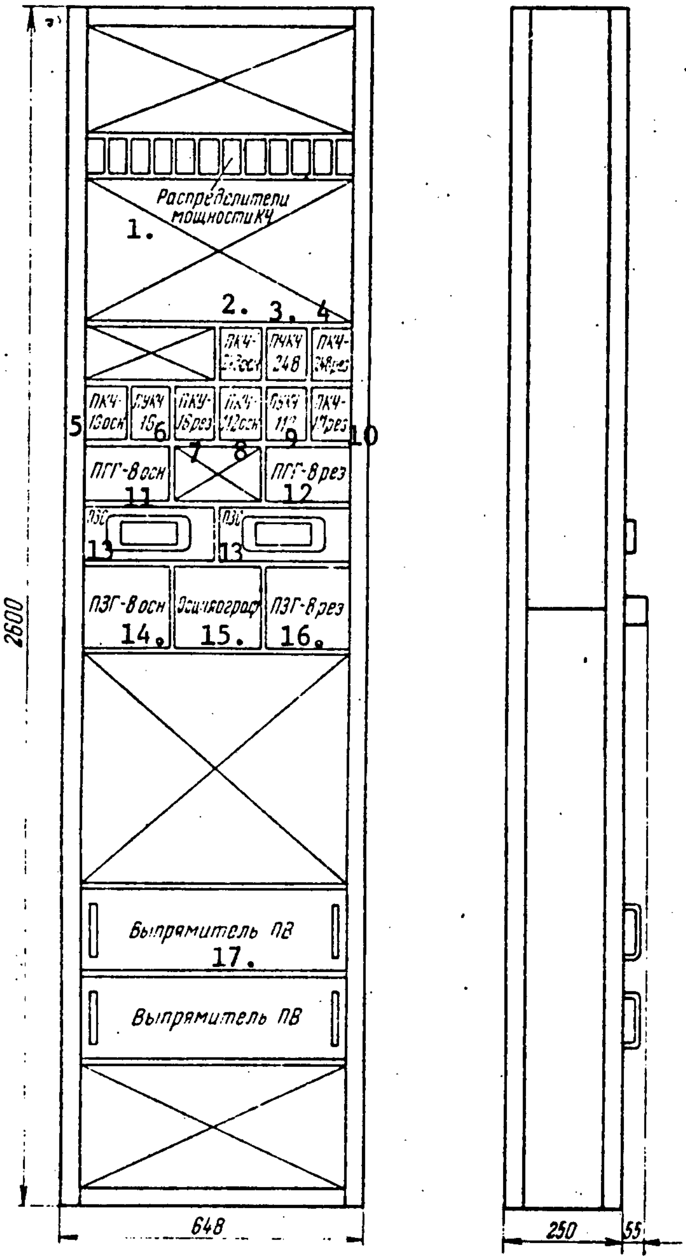


Рис. IV.8.15. Размещение оборудования на стойке контрольных частот СКЧ аппаратуры К-60п

Figure 4.8.15. Placement of the equipment in the SKCh control frequency rack of the K-60p equipment.

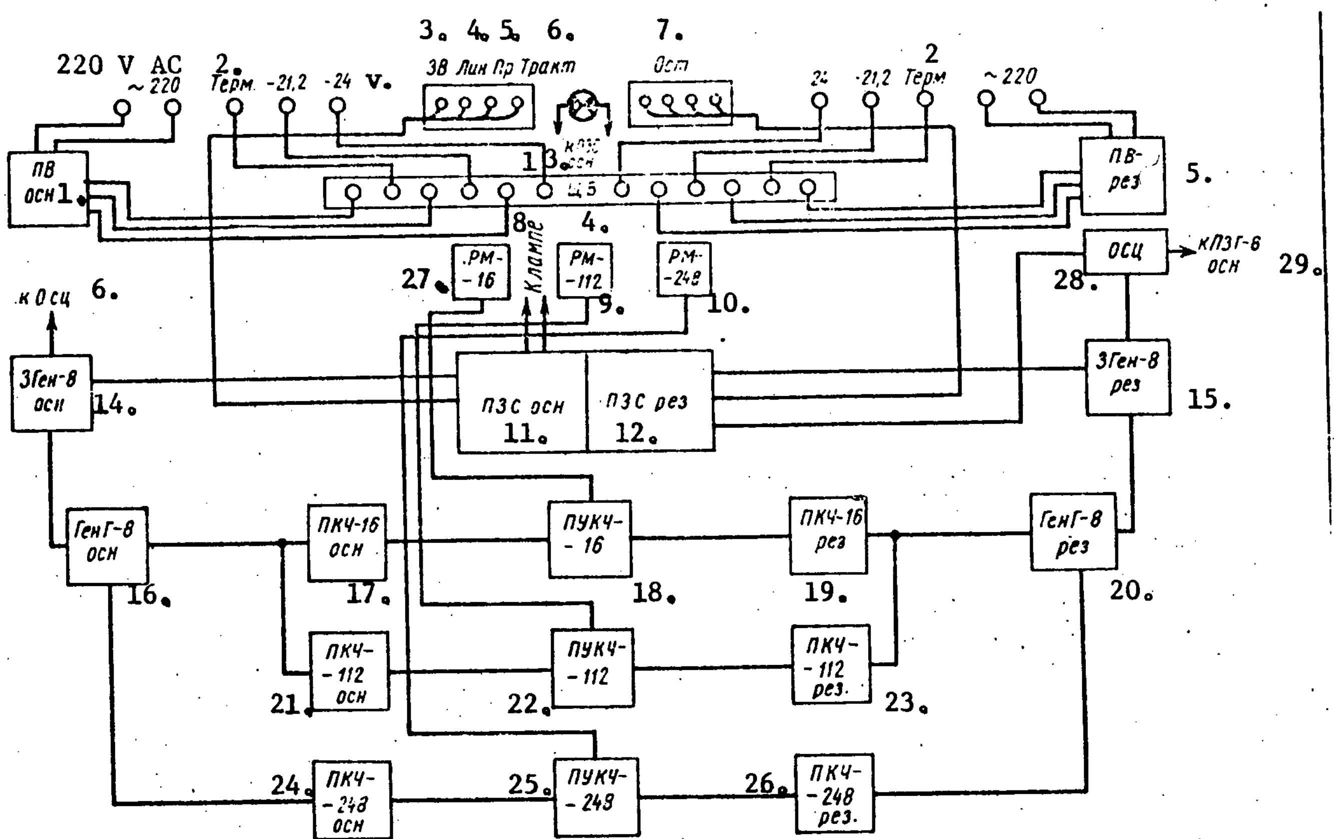


Рис. IV.8.16. Блок-схема стойки контрольных частот аппаратуры К-60п.

Figure 4.8.16. Block diagram of the control frequency rack of the K-60p equipment.

Key: 1. Main power supply;
2. Thermistor;
3. ZV [expansion unknown, or possible '3 volts'];
4. Line;
5. Receive;
6. Channel;
7. Ost [?remaining ones?];
8. To the lamp;

[Key to Figure 4.8.16, continued]:

9. RM-112 [112 KHz power distributor];
10. 248 KHz power distributor;
11. Main protection [fuse] and signaling panel;
12. Standby protection and signaling panel;
13. To the main protection and signaling panel;
14. ZGen-8 osn [?main, 8 KHz, master oscillator?];
15. Standby 8 KHz master oscillator?;
16. Gen G-8 osn [main 8 KHz harmonic generator];
17. Main 16 KHz control frequency receiver;
18. PUKCh-16 [?16 KHz control frequency switcher?];
19. Standby 16 KHz control frequency receiver;
20. Standby 8 KHz harmonic generator;
21. Main 112 KHz control frequency receiver;
22. 112 KHz control frequency switcher;
23. Standby 112 KHz control frequency receiver;
24. Main 248 KHz control channel receiver;
25. 248 KHz control frequency switcher;
26. Standby 248 KHz control frequency receiver;
27. 16 KHz power distributor;
28. Oscilloscope;
29. To the main PZG-8 [expansion unknown].

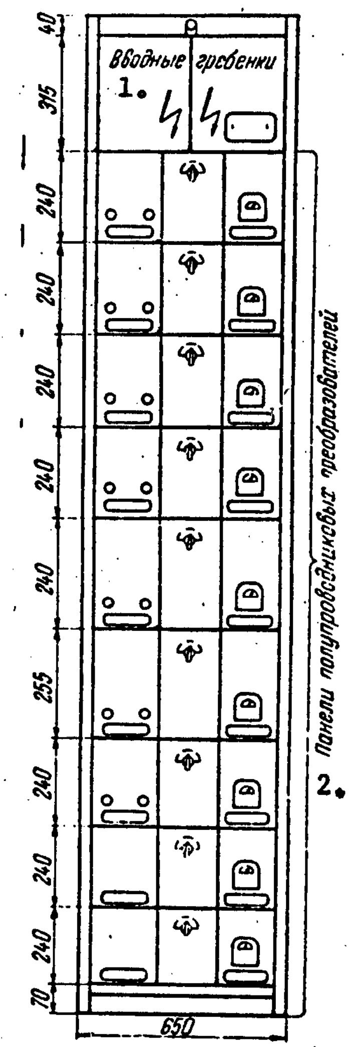


Рис. IV.8.17. Размещение оборудования на стойке дистанционного питания СДП аппаратуры К-60п

Figure 4.8.17. The placement of the equipment in the SDP remote power supply rack of the K-60p equipment.

Key: 1. Input terminal blocks;
2. Semiconductor inverter panels.

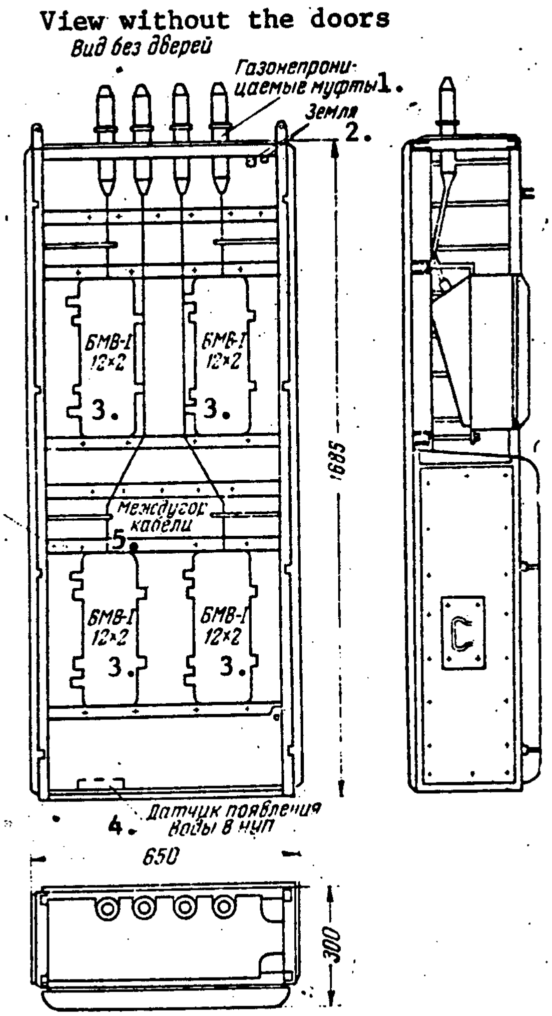


Figure 4.8.18. The placement of the equipment in the VSKh-1 cable entrance cabinet of the K-60p equipment.

Key: 1. Gas-tight couplings;
2. Ground;
3. BMV-1 12 x 2 moisture proof box;
4. Sensor for the appearance of water in the NUP [unattended repeater station].
5. Long distance [intercity] cable.

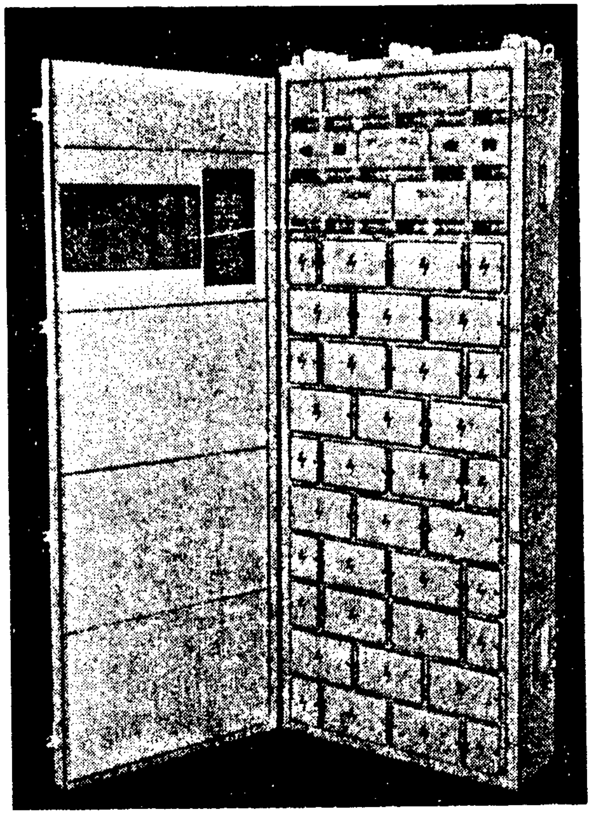


Figure 4.8.19. Exterior view of the SPUN rack of unattended intermediate amplifiers of the K-60p equipment.

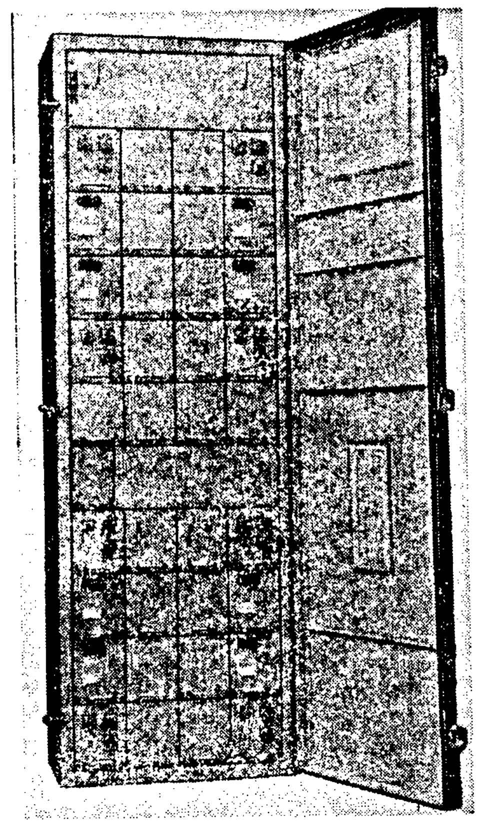


Figure 4.8.20. Exterior view of the SPUN-M [modernized] rack of unattended intermediate amplifiers of the K-60p equipment.

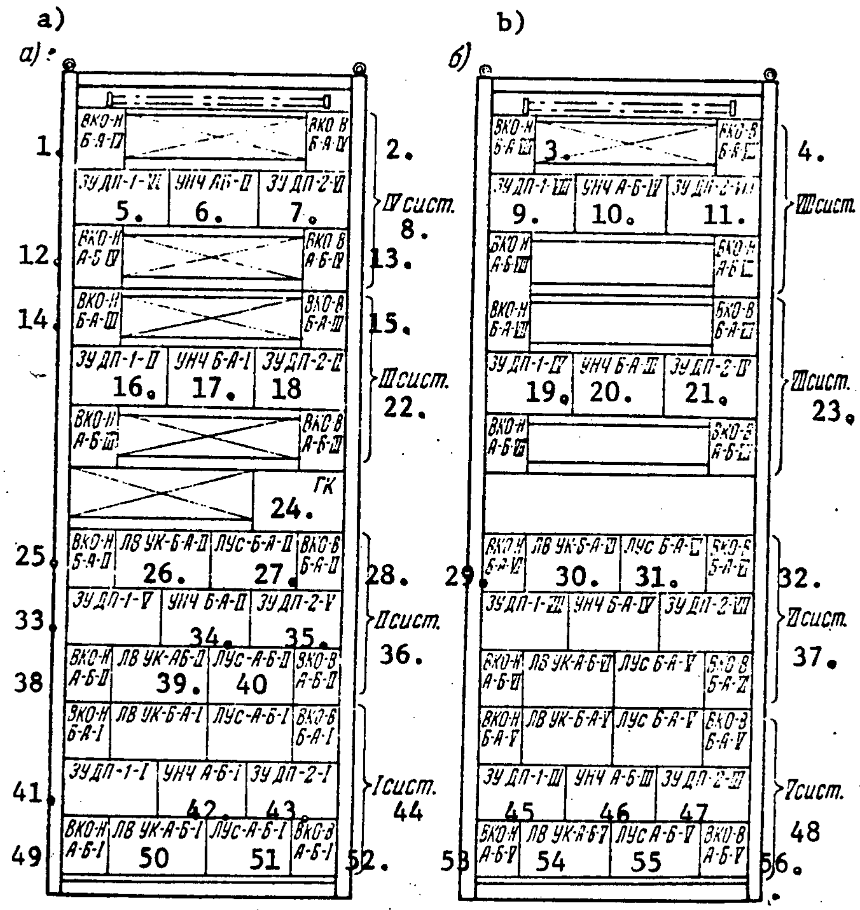


Figure 4.8.21. The placement of the equipment in SPUN rack of unattended intermediate amplifiers of the K-60p equipment (view with the door removed and without the covers of the blocks): a) SPUN-1; b) SPUN-2.

Key: 1. VKO-N B-A IV [low level cable entrance unit, B-A, system 4];
2. VKO-V B-A IV [high level cable entrance unit, B-A, system 4];
3. Low level cable entrance unit, B-A, system 8;
4. High level cable entrance unit, B-A, system 8;
5. ZU DP-1 VI [protective unit of remote power supply 1, system 6];
6. Low frequency amplifier for A-B, system 2;
7. Protective unit for remote power supply 2, system 6;
8. System 4;
9. Protective unit of remote power supply 1, system 8;
10. Low frequency amplifier for A-B, system 4;
11. Protective unit of remote power supply 2, system 8.
12. Low level cable entrance unit, A-B, system 4;
13. High level cable entrance unit, A-B, system 4;
14. Low level cable entrance unit, B-A, system 3;
15. High level cable entrance unit, B-A, system 3;
16. Protective unit of remote power supply 1, system 2;

[Key to Figure 4.8.21, continued]:

17. Low frequency amplifier for B-A, system 1;
18. Protective device of remote power supply 2, system 2;
19. Protective device of remote power supply 1, system 4;
20. Low frequency amplifier for B-A, system 3;
21. Protective device of remote power supply 2, System 4;
22. System 3;
23. System 7;
24. GK [monitor generator panel];
25. Low level cable entrance unit, B-A, system 2;
26. Line equalizer, UK [expansion unknown] for B-A, system 2;
27. B-A line amplifier, system 2;
28. High level cable entrance unit for B-A, system 2;
29. Low level cable entrance unit for B-A, system 6;
30. Line equalizer for UK, B-A, system 6;
31. B-A line amplifier, system 6;
32. High level cable entrance unit, B-A, system 6;
33. Protective device of remote power supply 1, system 5;
34. B-A low frequency amplifier, system 2;
35. Protective device of remote power supply 2, system 5;
36. System 2;
37. System 6;
38. Low level cable entrance unit, A-B, system 2;
39. Line equalizer UK for A-B, system 2;
40. A-B line amplifier, system 2;
41. Protective device of remote power supply 1, system 1;
42. A-B low frequency amplifier, system 1;
43. Protective device of remote power supply 2, system 1;
44. System 1;
45. Protective device of remote power supply 1, system 3;
46. A-B low frequency amplifier, system 3;
47. Protective device of remote power supply 2, system 3;
48. System 5;
49. Low level cable entrance unit, A-B, system 1;
50. Line equalizer, UK, A-B, system 1;
51. A-B line amplifier, system 1;
52. High level cable entrance unit, A-B, system 1;
53. Low level cable entrance unit, A-B, system 5;
54. Line equalizer, UK, A-B, system 5;
55. A-B line amplifier system 5;
56. High level cable entrance unit, A-B, system 5.

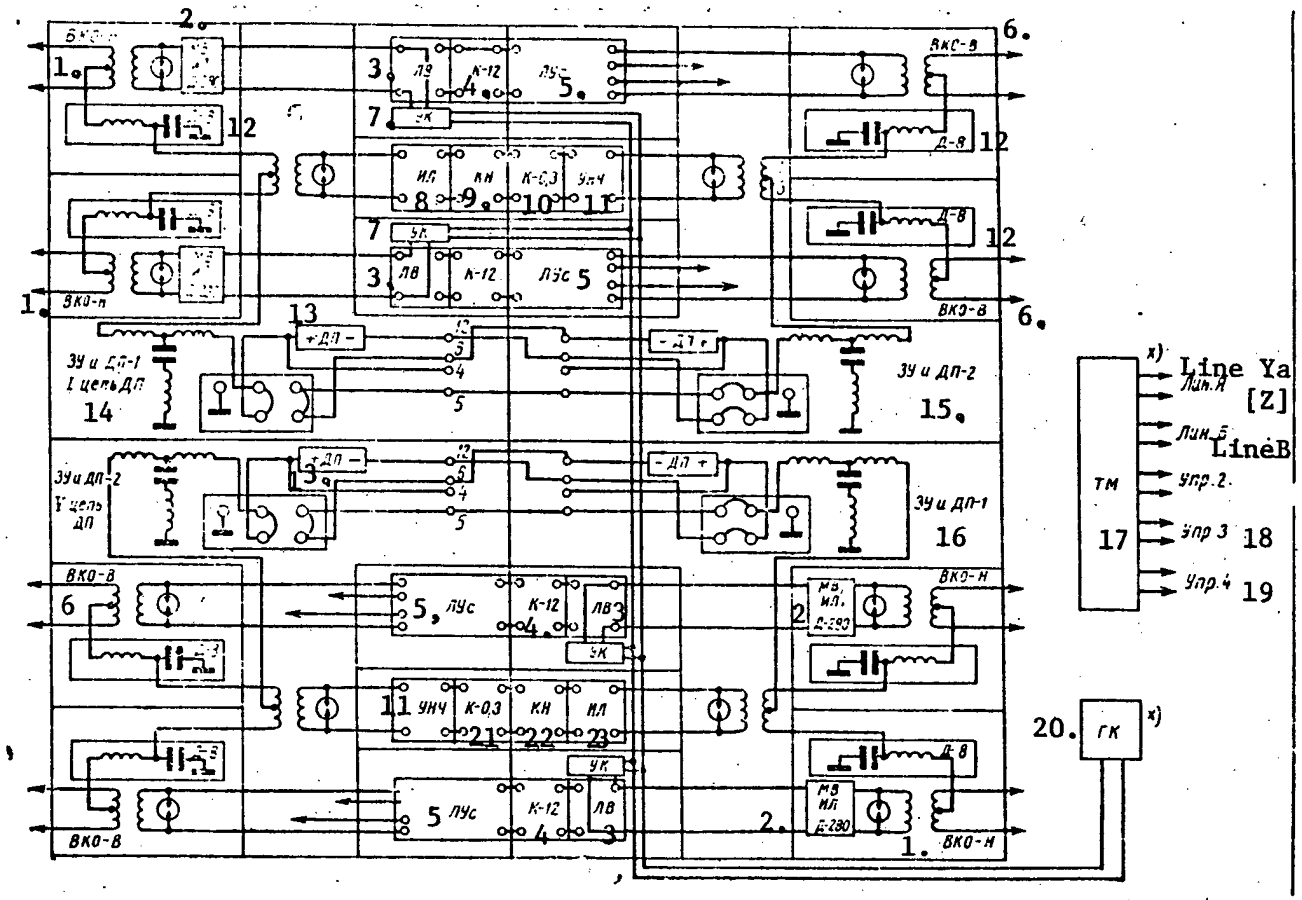


Figure 4.8.22. Block diagram of the SPUN K-60p equipment.

Key: 1. VKO-N [low level cable entrance unit];
2. Trunk equalizer, phantom line, D-230 filter;
3. LV [line equalizer];
4. K-12 filter;
5. Line amplifier;
6. VKO-V [high level cable entrance unit];
7. UK [expansion unknown];

[Key to Figure 4.8.22, continued]:

8. Phantom line;
9. KN [?alignment network?];
10. K-0.3 filter;
11. Low frequency amplifier;
12. D-8 filter;
13. Remote power supply;
14. Protective device and remote power circuit 1, circuit I of the remote power supply;
15. Protective device and remote power circuit 2;
16. Protective device and remote power circuit 1;
17. Remote control panel;
18. Control circuit 3;
19. Control circuit 4;
20. Monitor generator panel;
21. K-0.3 filter;
22. KN [?alignment network?];
23. Phantom line.

[Key to Figure 4.8.23, page 360]:

1. Low level cable entrance unit;
2. VCh-1 [high frequency unit 1];
3. Line;
4. Station;
5. Phantom line or D-280 filter;
6. Trunk equalizer;
7. Line equalizer;
8. RU [?level control?];
9. IL [phantom line];
10. KN [?alignment network?];
11. K-0.3 filter;
12. Line amplifier;
13. Low frequency amplifier;
14. High level cable entrance unit;
15. GK [monitor generator panel];
16. NCh [low frequency];
17. VCh-11 [high frequency unit 11];
18. Protective device, remote power circuit 1;
19. DP [remote power supply];
20. Protective device, remote power circuit 2;
21. PVG [?secondary group converter?];
22. Protective device, remote power circuit 2;
23. TM [remote control panel];
24. K-12 filter.

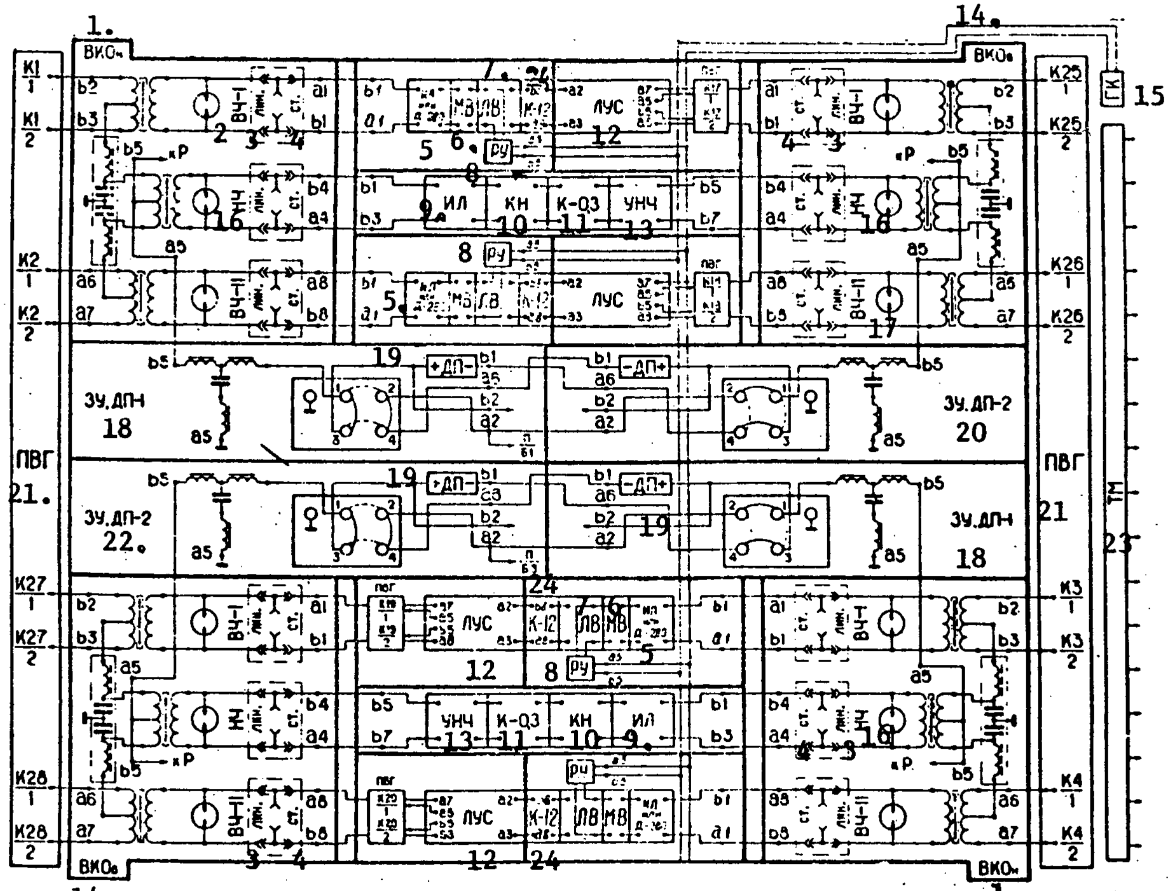


Рис. IV.8.23. Блок-схема аппаратуры СПУН-М К-60п

Figure 4.8.23. Block diagram of the SPUN-M K-60p equipment.

[Key on preceding page, 359]

4.9. The V-60-E and V-60-S 60-Channel Transmission Systems (Manufactured in the German Democratic Republic)

Figures 4.9.1 - 4.9.22.

Purpose:

Intended for multiplexing balanced, non-coil-loaded cable communications lines. In terms of its technical characteristics, the V-60-S equipment is close to the K-60 type equipment, and was used only terminal stations. The equipment needed for the organization of a line channel, the remote power supply, service communications equipment, etc., were of domestic manufacture. The V-60-S equipment has not been supplied since 1967. In terms of its technical characteristics, the V-60-E equipment is close to the K-60p equipment, and is supplied for terminal and intermediate (attended and unattended) stations.

Given below are data on the V-60-E system when the V-60-E is used in OP's, OUP's and NUP's. Also given in the electrical power supply, equipment complement, weight and cost sections are the data for the V-60-S terminal stations.

Note: When setting up a 60-channel communications system using the V-60-S equipment at terminal stations, the data given in Section 4.7 for the K-60 system are to be used, for the case of a trunk of more than 250 km, equipment with three-frequency AGC is to be installed at the OUP closest to the OP.

Type of Line: Balanced cables with 1.2 mm diameter copper cores (MKSB, MKB MKPV, MKSA).

Communications System: Two-cable, single-band.

Electrical Characteristics

The line frequency spectrum The inverse spectrum should be used for one of the systems operating on one quad (where the communications length is more than 250 km). The 252 - 280 KHz spectrum is used for remote monitoring.	12 - 252 KHz
The effectively transmitted passband	300 - 3,400 Hz
The number of channels which can be organized	60
The secondary multiplexing capability	See the introduction
The maximum length of a low frequency retransmission section	2,500 km
The number of low frequency retransmission sections	5
The maximum communications range	12,500 km

The nominal length of a repeater section of a trunk on an OUP-OUP section Where a_{nom} is the nominal attenuation of a repeater section; $\alpha_{t\ max}$ is the attenuation factor of the cable at the maximum ground temperature.	$a_{nom}/\alpha_{t\ max}$
The length of repeater sections for MKSB cable	17 - 22 km
The average length of a repeater section	20 km
The input impedance of the equipment from the line end:	
NUP	150 ohms
OP and OUP	135 ohms
The permissible deviation of the reflection factor of a station	$p \leq 0.12\sqrt{252/f}$, but no more than 0.2.
The attenuation of two line transformers	0.1 Np
The residual channel attenuation at 800 Hz	0.8 Np
The nominal relative voice frequency levels of the four-wire section of a channel:	
At the input	-1.5 Np
At the output	+0.5 Np
The nominal relative transmit levels through the channels at the line amplifier output, with respect to power:	
-- Without skewing [of the frequency response] (can be used on short trunks up to 250 km)	- 0.55 Np
-- With skewing: With respect to the 60th channel	- 0.1 Np
With respect to the first channel	- 1.3 Np
The internal noise level in the spectrum of one telephone channel, referenced to the line amplifier input:	
At NUP's	- 15.3 Np (252 KHz) - 14.8 Np (12 KHz)
At OUP's	- 15.3 Np (252 KHz) - 14.8 Np (12 KHz)
At OP's	- 14.9 Np (252 KHz) - 14.5 Np (12 KHz)

Note: A provision is made at OUP's for the segregation of four channels, of one (12 - 60 KHz) or two (12 - 108 KHz) 12-channel groups from the main spectrum. On one retransmission section, it is permissible to set up one HF transit when using the existing through working equipment, as well as to organize no more than three segregation points, and in this case, the edge channels of the forward transmission route should not be employed for through working. Amplifiers having three-frequency AGC are installed at OUP's where the channels are split out.

The distribution of noise power, introduced by the line channel, in the upper channel of the system (thermal, nonlinear and linear)	1 : 1 : 2

The attenuation of nonlinearity for the case of a zero level at the output (with respect to power) and a gain of the amplifiers of 6.0 Np:

	252 KHz, Np	12 KHz, Np
OUP's and NUP's:		
a_{2h}	10	11.0
a_{3h}	12.5	13.5
OP's:		
a_{2h}	9.5	-
a_{3h}	12.0	-

The gain of the amplifiers at 252 KHz for the average repeater section length and when the AGC controls are set in the middle:

For NUP's	5.7 ± 0.7 Np
For OUP's	5.75 ± 0.05 Np (without considering the attenuation of cable entrance unit panels)

Maximum Gain: For NUP's	6 ± 0.3 Np
For OP's and OUP's	7.0 Np

The equalizing capability of the amplifiers:

The difference in the attenuations of the constant slope network between 247 and 17 KHz in the negative feedback circuit:

For OP's and NUP's	1.5 Np
For OUP's	1.2 Np

The line equalizers of the amplifiers in the OUP's for the following cables:

MKSB	LV [line equalizers]: 17 km, 18 km, 19 km, 20 km, 21 km and 22 km.
MKB	LV: 15 km, 16 km, 17 km, 18 km, 19 km and 20 km.
MKPV	LV: 12 km, 13 km, 14 km, 15 km and 16 km.

The cosine corrective networks, installed in the OP's and OUP's can make a correction within limits of	± 0.3 Np

The number of service links, provided for servicing a trunk:

Trunk service communications link, MSS	1
Station-to-station service communications link, PSS	2
Sectional service communications link, USS	1

The PSS and USS service communications links are organized via the phantom circuits of a cable.

The number of remotely powered NUP's between two power supply stations, working from the remote power supply voltage via the following circuits, is:

"wire-wire"	6
"wire-ground"	12

Note: In individual cases, when specially justified, it is permissible to increase the number of NUP's up to 14 (in the absence of external electromagnetic influences).

The permissible voltage (longitudinal e.m.f.) due to the influence of an AC electrified railroad and electrical power transmission lines on a repeater section:

Long term	200 volts eff.
Short term (no more than 4 sec.)	400 volts eff.

The grounding devices:

-- For NUP's, when powered in a: "wire-ground" circuit configuration:	
NUP's within a remote power section	One working ground (or protective)
NUP's at the end of a remote power section	Two grounds: a working and a protective one
"wire-wire" circuit configuration	One ground: a working one (or protective one).
-- For OP's, OUP's	Three grounds: a working and two metering ones.

Note: The resistance of each ground should be in accordance with GOST 464-68.

The AGC system:

In NUP amplifiers (including the voice frequency channel)	Based on the ground temperature
In OUP amplifiers	Electromechanical, two- and three-frequency
In OP amplifiers	The same, three-frequency

Control frequencies:

Slope	16 KHz
Curvilinear	112 KHz
Flat	248 KHz
In the primary group receive channel	84.14 KHz
In the secondary group receive channel	411.86 KHz

Note: The control error using the 16, 112 and 248 KHz control frequencies amounts to $\leq$ 0.07 Np, while for the case of AGC based on the ground temperature, it is $\pm$ 0.3 Np on an OUP-OUP section.

The phantom lines, inserted in the NUP, OUP and OP equipment at the HF channel input	3 km, 6 km, 3 + 6 km
Trunk equalizers (MV's) are provided for installation at the input to the NUP amplifiers	The MV attenuation is determined by means of a portable, variable MV

Climatic Operational Conditions

Attended Stations. At temperatures of from +10 to +40° C, and a humidity of 75%, and a short term exposure to 80% at +25° C.

Unattended Stations. At temperatures of from -10 to +35° C, and a humidity of 85%, and a short term exposure to 98% at +30° C.

The Electrical Power Supply

Voltages:

-- Terminal and attended intermediate stations:

Plate	206 volts ± 3%
Filament	21.2 volts ± 3%
Signaling	24 volts ± 10%
AC mains	220 volts, +5 and -15%, at 48 - 51 Hz

-- Unattended repeater stations:

Remote power (DC), fed into the line (max)	450 volts
Adjusted in steps of	50 volts each
The voltage drop across the terminals of the power supply equipment (the NUP amplifiers of one system are connected in series)	51 ± 3 volts

Current and Power Consumption of the V-60-E

Equipment	21.2 volts amps	24 volts amps	220 volts VA
ShNCh for 60 channels:			
Main circuits	0.645	-	-
The same, when the ringing circuits have a 50% working load	2.8	-	-
Signaling	-	0.4	-
ShKP using direct current:			
Main circuits	2.0	-	-
Signaling	-	0.5	-
ShKP using alternating current	-	-	100
ShGU for one system:			
Main circuits	2.4	-	-
Signaling	-	1.0	-

Current and Power Consumption of the V-60-E [continued]

Equipment	21.2 volts amps	24 volts amps	220 volts VA
ShGU for four systems:			
Main circuits	6.2	-	-
Signaling	-	1.0	-
ShGNK:			
Main circuits, main power	5.0	-	-
Signaling and thermostats	-	6.0	-
Main circuits, standby power	5.0	-	-
Signaling and thermostats	-	6.0	-
Oscilloscope	-	-	10.0
ShLU OP for two systems using AC, with the generator equipment	-	-	280
ShLU OP for one system, using DC, with the generator equipment	1.4	0.5	-
The same, for four systems	5.6	0.5	-
Oscilloscope for all types of ShLU OP's	-	-	10.0
ShVKO:			
Main circuits	0.7	-	-
Signaling	-	0.2	-
ShLU OUP for 1 - 4 systems:			
Main circuits	1.5-6.0	-	-
Signaling	-	0.8	-
ShDP:			
Main circuits (maximum)	80.0	-	-
Signaling	-	5.0	-
ShLU NUP (powered remotely)	-	0.2-0.3 60 volts	-

Notes: 1. In addition to the equipment enumerate here, a head end cabinet (GSh-1) should be provided for the V-60-E terminal stations for the distribution of the power to the racks of a row.

Current consumption for the GSh-1:

-- Alternating current, 220 volts ± 10%	1.5 amps
-- Direct current:	
21.2 volts ± 3%	0.32 amps
24 volts ± 10%	3.0 amps
206 volts ± 3%	0.05 amps
-- Ringing voltage at 60 - 90 volts	0.05 amps

2. The ShNCh and ShKP cabinets can be powered from the AC mains, something which is specified when ordering. In this case, rectifiers are supplied by the manufacturing plant instead of DC distribution panels.

The V-60-E Equipment Complement

Terminal Station:

ShVKO. A cabinet for connecting in two high and low level cables, which is intended for isolating and matching a line to the HF communications equipment. Located in the cabinet are: two cable boxes, each for 4 x 4 cable; a remote control unit for receiving signals from NUP's and transmitting control instructions to NUP's; filters for protecting against the influence of electrified railroads and high voltage lines on the HF communications systems; two grounding bolts (a working and a protective one).

Note: When higher requirements are placed on the crosstalk attenuation (above 10 Np), two ShVKO cabinets are to be provided at OP's for bringing in the low level cables to one cabinet and the high level cables to the other cabinet.

ShLU-OP. A terminal station, line amplifier cabinet, intended for compensating for the attenuation of an adjacent cable section, compensating for distortions, and automatic transmit gain control. Over short line sections, a provision is made for the connecting in of phantom lines. To balance out the systematically accumulating errors in a system, there are trunk equalizers in the ShLU-OP cabinet.

The ShLU-OP cabinet is fed the 16, 112 and 248 KHz control frequencies from the ShGNK cabinet, and in this case, the equipment for four V-60-E systems is housed in the ShLU-OP cabinet. There is the option of ordering a cabinet with the generator equipment for the control frequencies cited above. In this regard, a provision is made for housing the 16, 112 and 248 KHz control frequency generator equipment in the cabinet, as well as the cabinet power supply blocks for using the AC mains. In this case, housed in the cabinet is the equipment for two V-60-E systems. A provision is also made in the cabinet, in addition to the equipment enumerated above, for a cosine corrective network (stipulated when ordering). For complete multiplexing of a 4 x 4 cable with the V-60-E system, it is necessary to install two ShLU-OP cabinets without generator equipment.

ShGU. A cabinet of group devices, intended for deriving the first secondary group from five primary groups. For the case of conversion with a frequency of 564 KHz, the secondary group is converted to the first secondary group in the 12 - 252 KHz range, and in this case, the fifth primary group is transmitted in the 12 - 252 KHz frequency range. Back conversion is accomplished on receive. Provisions are made in the ShGU for the option of through-working of the secondary group in the 312 - 552 KHz spectrum, and the feeding of this spectrum to a RRL [radio relay link]. When individual equipment is lacking at the LATs [line equipment shop], a provision is made for the capability of feeding the 84.14 KHz control frequency, as well as for isolating and inserting broadcast programs in the two 12-channel blocks; the ShGU allows for the insertion of the 411.84 KHz control frequency.

The ShGU cabinet is designed for 1 - 4 V-60-E systems.

ShGNK. The carrier and control frequency generator cabinet, intended for supplying the V-60-E terminal equipment with the carrier and control frequencies. Besides the generator equipment, also housed in the cabinet are a level meter and an oscilloscope. The generator equipment of the cabinet produces the following:

The carrier frequencies of the channels .	12, 16 and 20 KHz
The pregroup carrier frequencies	84, 96, 108, and 120 KHz
The carrier frequencies of the inverse spectrum	252, 300, 348, 396 and 444 KHz
The carrier frequencies of the primary groups...............................	420, 468, 516, 564 and 612 KHz
The carrier frequency of the secondary groups	564
The line control frequencies	16, 112 and 248 KHz
The control frequency of the secondary groups...............................	84.14 KHz
The control frequency of the secondary groups	411.86 KHz
The auxiliary frequency	496 KHz

ShGNK cabinet is designed for providing the control and carrier frequencies for eight V-60-E systems.

Note: The auxiliary frequency (496 KHz) was lacking in the ShGNK V-60-S equipment cabinet, while the control frequencies of the primary and secondary groups (84.14 KHz and 411.86 KHz, respectively), were generated in the ShGU cabinet. For this reason, the generator equipment of the V-60-S system cannot drive the V-60-E systems.

ShKP. The cabinets of channel convert rs, intended for channel and pre-group conversions so that in the transmit direction, 23 groups are formed from 60 HF channels (300-3400 Hz) in a frequency range of 12.3 - 23.4 KHz by means of the 12, 16 and 20 KHz carrier frequencies. Each four pregroups, which are incorporated in one primary group, are converted by means of 84, 96, 108 and 120 KHz carriers to the 60.6 - 107.7 KHz primary group frequency range. All tolled, five primary groups are generated in the cabinet. Back conversion is accomplished in the receive direction. Also in the cabinet there is a device for organizing a broadcast channel via built-in HF channels in a frequency range of 84 - 96 KHz (4, 5 and 6 HF channels). In this case, it is necessary to take into account the fact that the cabinet has generator equipment at a frequency at 96 KHz and a switching carrier frequency of 108 KHz. The cabinet permits the insertion of the 84.14 KHz control frequency. Through working can be organized in the cabinet for three primary groups.

The ShKP cabinet is designed for one V-60-E system.

ShNCh. The low frequency equipment cabinet, which contains 60 modules with different systems and 60 modules with voice frequency ring receivers.

Besides this, there are generator and monitor-measurement modules in the cabinet. The cabinet is designed for the connection of 60 channels.

ShDP. The remote power supply cabinet is intended for providing remote electrical power for the NUP equipment of the V-60-E system via the phantom circuits of a balanced cable. The ShDP cabinet contains eight operational remote power transmit panels (PDP) and one standby remote power transmission panel intended for test purposes.

The PDP panel contains a voltage transformer, which converts the working voltage of 21.2 volts to the remote power supply voltage of 500 volts by means of an electronic chopping inverter, which converts DC to AC. There are three terminals in the upper part ShDP to each of which three PDP boards each are connected, or four PDP (working) boards each are connected to terminals one and two. All three terminals are connected to the -24 volt power feeder. In the lower part of the ShDP there is a plugged socket to which the mains voltage is brought in. On the center panel of the ShDP there is a switch for switching the remote power supply voltage polarity.

GSh-1. A headend rack for the distribution of the electrical power to the cabinets of the row of V-60-E racks.

Located in the upper part of the GSh-1 are signal lamps, which provide information on faults in the cabinets of the row of V-60-E racks or concerning flucuations in the input voltages. Also located there are blocks with terminals for bringing in the power buses, the fuses, and signal lights for each type of voltage. Located in the center of the cabinet is a panel with equipment for service communications (intraexchange, with a GTS-ATS) [municipal automatic telephone exchange]. Located in the lower part of the GSh-1 are terminals for bringing in the ring and signal voltages, a signaling and service communications relays, and fuses. The power supply block, which operates from the AC mains, and which serves as the standby source of signal voltages, is located at the very bottom of the cabinet.

GSh-2. A headend cabinet accessory, intended for setting up a row of V-60-E cabinets. It is ordered where necessary.

The Attended Intermediate Station

ShVKO. Two cabinets, each for connecting into high or low level cables.

ShLU-OUP. A cabinet of line amplifiers for an OUP, intended for compensating for the attenuation of an adjacent cable section, compensating for distortions, and automatic equalization of the transmit level. The cabinet is designed for four V-60-E systems.

ShDP. Two cabinets, each for eight remote power circuits.

The V-60-E Unattended Intermediate Station

Intended for amplifying and equalizing the line frequency spectrum of four 60-channel V-60-E systems. Also housed in the cabinet are matching transformer and remote power supply instruments, voice frequency service communications channel amplifiers, and filters for protecting against the influence of electrified railroads, and electrical power transmission lines. Two cabinets are required for the complete multiplexing of a 4 X 4 cable: cabinet No. 1 with the remote control, and cabinet No. 2 without remote control. For seasonal control based on the cable temperature, ground referenced AGC units are provided: three blocks of temperature transducers, one of which is intended for voice frequency channel AGC. There is also the option in the NUP of connecting in a telephone handset for service communications, for which there are plug-in sockets both inside and outside the NUP. There is a 275 KHz remote monitor generator, which is remotely switched form the OUP. The remote control unit, in addition to the generator, has a sensor for the timing pulses of notification signals. The second NUP cabinet is powered from the remote control block of the first NUP.

A portable telephone handset for service communications.

A selective level meter.

A 3, 6 and 9 km phantom line (or trunk equalizer).

Dimensions of the Cabinets

ШВКО — 2600×600×225 мм. ShVKO
ШЛУ-ОП — 2600×600×225 мм. ShLU-OP
ШГНК — 2600×600×225 мм. ShGNK
ШКП — 2600×600×225 мм. ShKP
ШДП — 2600×600×225 мм. ShDP
ГШ-1 — 2600×225×225 мм. GSh-1
ГШ-2 — 2600×225×225 мм. GSh-2
ШЛУ-ОУП — 2600×600×225 мм. ShLU-OUP
НУП V-60-E — 1400×520×250 мм. NUP V-60-E

Basic Data on the V-60-S Equipment

The V-60-S equipment was supplied prior to 1967, and has now been modernized. In terms of its electrical characteristics, the V-60-S equipment is close to the K-60 equipment.

The maximum length of a low frequency retransmission section:

When the system operates without skewing [of the frequency response], and in the absence of an OUP with curvilinear AGC in the channel	250 - 300 km

When the system operates with skewing, and where the OUP closest to the OP [terminal station] has curvilinear AGC, and the multiplexed pairs are in different quads	1,000 - 1,200 km
When multiplexing and multiquad and single quad cable with two systems in one quad (because of the absence of the inverse spectrum)	No more than 700 km

Notes: 1. No provision is made in the V-60-S equipment for line AGC using control frequencies. A provision is made at the terminal station for only feeding three control frequencies (16, 112, and 248 KHz) into the line, but a provision is made for AGC using the 84.14 control frequency for the primary groups.

2. When designing a 60-channel system using the V-60-S equipment at the terminal stations, and domestic equipment at the intermediate stations, the data presented in Section 4.7 for the K-60 equipment is to be employed.

The Equipment Complement of the V-60-S Equipment

The V-60-S Terminal Station Supplied Prior to 1964:

The ShNCh low frequency equipment cabinet with differential systems and ring receivers (for 30 channels)	2 units
The ShKP cabinet of channel converters	1 unit
The ShGU cabinet of primary group converters	1 unit
The ShGNK generator equipment cabinet	1 unit
The GSh-1 and GSh-2 head-end cabinets	2 units
Open overhead channels	1 unit
Intercabinet wiring (cable package)	1 unit

Note: The station was supplied as a complete set with head-end cabinets, open overhead channels and intercabinet wiring.

The V-60-S Terminal Station Supplied after 1964

Depending on the number of racks ordered, and the order for their placement in the line equipment shop rows, 16 different equipment complements of the V-60-S were produced:

ГШ-1, ШНЧ-1, ШНЧ-2, ШКП, ШГУ, ШГНК, ГШ-2;
ГШ-2, ШНЧ-2, ШНЧ-1, ШКП, ШГУ, ШГНК, ГШ-1;
ГШ-2, ШГНК, ШГУ, ШКП, ШНЧ-1, ШНЧ-2, ГШ-2;
ГШ-2, ШГНК, ШГУ, ШКП, ШНЧ-2, ШНЧ-1, ГШ-1;
ГШ-1, ШНЧ, ШГУ, ШКП, ШГНК, ГШ-2;
ГШ-2, ШНЧ, ШГУ, ШКП, ШГНК, ГШ-1;
ГШ-1, ШГНК, ШГУ, ШКП, ШНЧ, ГШ-2;
ГШ-2, ШГНК, ШГУ, ШКП, ШНЧ, ГШ-1;
ГШ-1, ШНЧ-1, ШНЧ-2, ШКП, ШГУ, ГШ-2;
ГШ-2, ШНЧ-2, ШНЧ-1, ШКП, ШГУ, ГШ-1;
ГШ-1, ШГУ, ШКП, ШНЧ-1, ШНЧ-2, ГШ-2;
ГШ-2, ШГУ, ШКП, ШНЧ-2, ШНЧ-1, ГШ-1;
ГШ-1, ШНЧ, ШКП, ШГУ, ГШ-2;
ГШ-2, ШНЧ, ШКП, ШГУ, ГШ-1;
ГШ-1, ШГУ, ШКП, ШНЧ, ГШ-2;
ГШ-2, ШГУ, ШКП, ШНЧ, ГШ-1.

Notes: 1. Besides those indicated, other types of equipment complements were also supplied, in particular, individual bays.

2. The input-switching equipment, the remote power supply equipment, service communications unit, etc., were of domestic production.

3. The dimensions of the cabinets are the same as for the V-60-E system cabinets.

Current Consumption of the V-60-S Terminal Equipment Supplied Prior to 1964

Racks	220 volts AC VA	206 volts DC amps
Low frequency cabinet for 30 channels, ShNCh	100	-
Cabinet of channel converters, ShKP	100	-
Cabinet of group converters, ShGU	300	1.4
Generator equipment cabinet, ShGNK	350	1.4
Head-end power distribution cabinet, GSh-1	170	-
V-60-S terminal station (of 5 racks)	1,020	2.8

Note: Since 1964, the manufacturing plant has produced the V-60-S equipment in a rack by rack equipment complement with the capability of powering the racks from the AC mains or from DC sources.

Current Consumption of the V-60-S Terminal Equipment Supplied After 1964

Racks	220 volts AC VA	21.2 volts DC amps	206 volts DC amps
ShNCh for 30 channels	100	3.5	-
ShNCh for 60 channels	100 - 200	1 - 3.0	-
ShKP	100	1.8	-
ShGU	300	10.0	1.4
ShGNK	350	10.0	1.4

Weight V-60-S Equipment

Equipment	Weight, kg
ShNCh for 60 channels	250
ShKP	280
ShGU (ShPP)	250
ShGNK	300

ShNCh for 60 channels Spare parts ShKP Spare parts ShGU for four systems Spare parts	The approximate weight of the racks is 300 - 400 kg (each)

[Approximate weight of the following racks is 300 - 400 kg (each)]:

ShGNK
 Spare parts
ShLU OP for four systems without the control frequency generator
 Spare parts
ShLU OUP-2 for one system
ShLU OUP-3 for one system
ShVKO with the remote control equipment, four systems
ShDP for eight remote power circuits
ShLU NUP for four systems
GSh-1
GSh-2
Cabinet of rectifiers

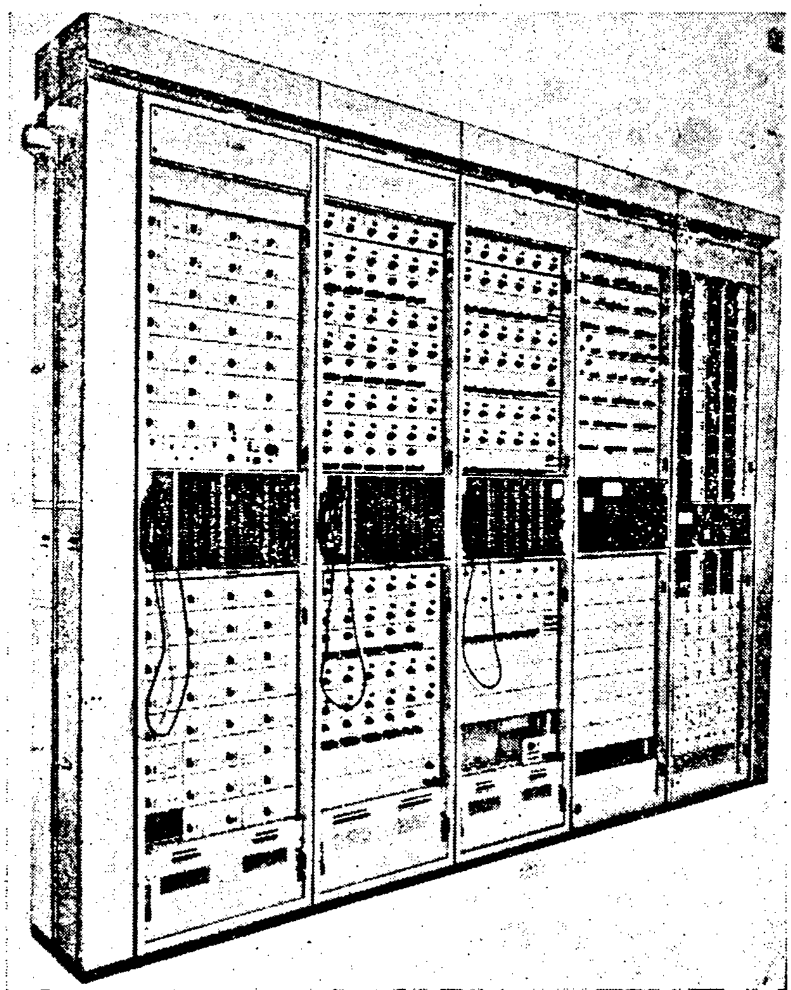


Figure 4.9.1. Exterior view of the terminal station of the V-60-E equipment.

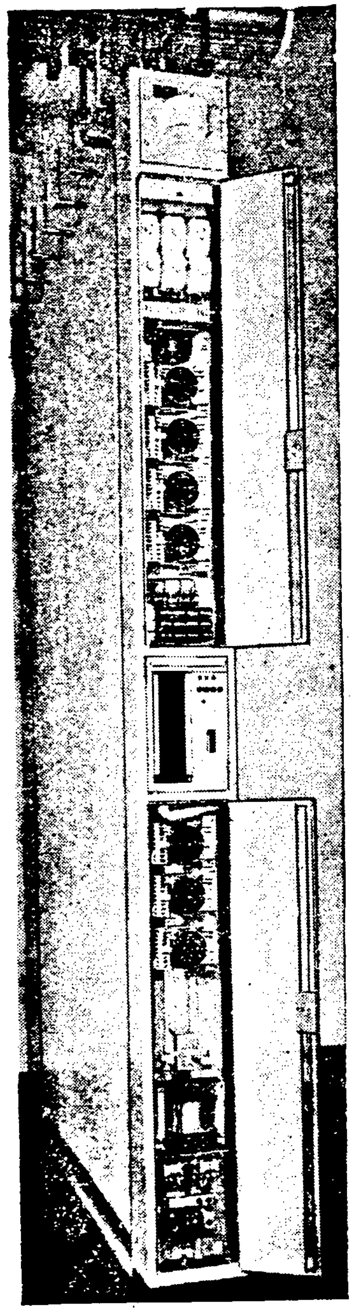


Figure 4.9.2. Exterior view of the terminal station of the V-60-E equipment from the end face of the GSh head-end cabinet.

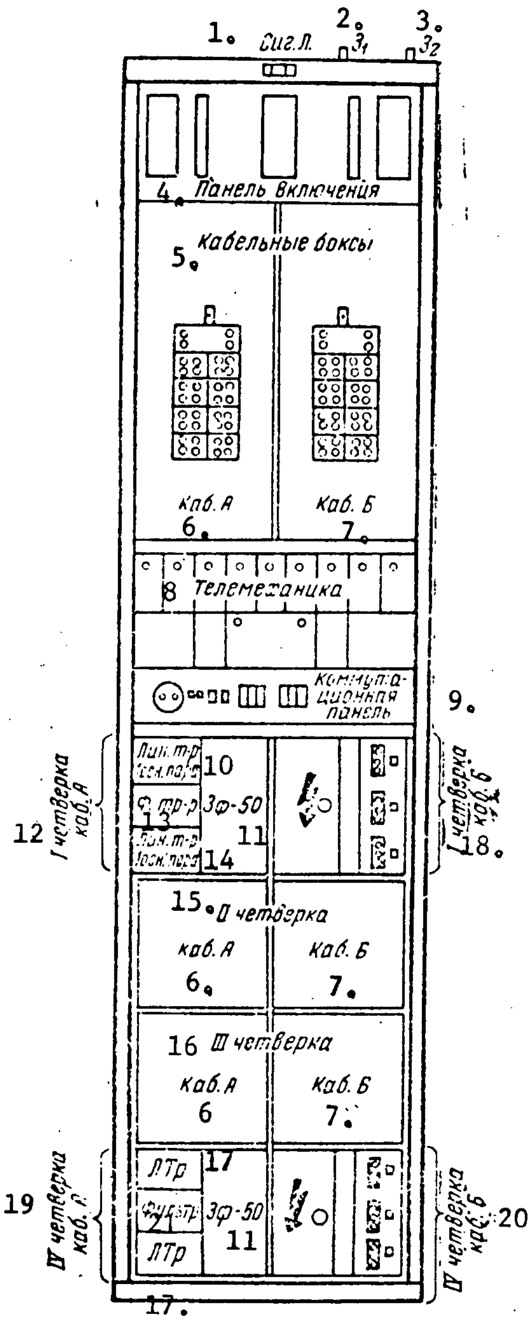


Figure 4.9.3.

The placement of the equipment in the ShVKO cable entrance equipment cabinet of the V-60-E equipment

Key:

1. Signal light;
2. Z_1 [?grounding terminal 1?];
3. Z_2;
4. Connection panel;
5. Cable boxes;
6. Cable A;
7. Cable B;
8. Remote control;
9. Switching panel;
10. Line transformer, main pair 1;
11. ZF-50 [?50 Hz suppression filter?];
12. Quad 1 of cable A;
13. Phantom transformer;
14. Line transformer, main pair 1;
15. Quad 2;
16. Quad 3;
17. Line transformer;
18. Quad 1 of cable B;
19. Quad 4 of cable A;
20. Quad 4 of cable B;
21. Filter.

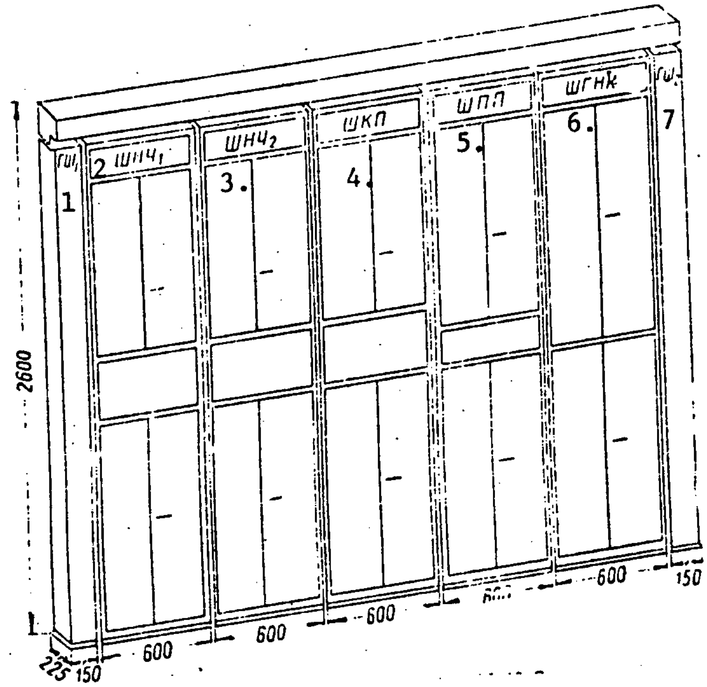


Figure 4.9.4. The V-60-S equipment complex.

Key: 1. GSh_1 [head-end cabinet 1];
2. $ShNCh_1$ [low frequency equipment cabinet 1];
3. $ShNCh_2$;
4. ShKP [channel converter rack];
5. ShPP [expansion unknown];
6. ShGNK [carrier and control frequency generator cabinet];
7. GSh_2 [head-end cabinet 2].

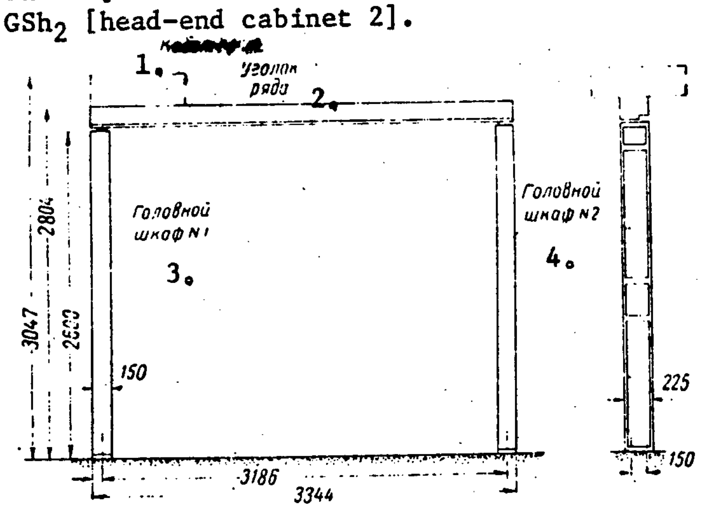


Figure 4.9.5. The installation of the terminal station of the V-60-S and V-60-E equipment.

Key: 1. [illegible - unknown type of cable installation];
2. Corner of the row;
3. Head-end cabinet No. 1;
4. Head-end cabinet No. 2.

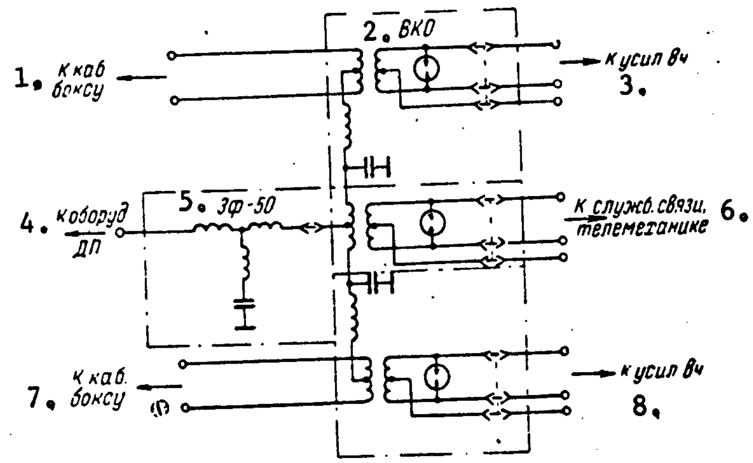


Figure 4.9.6. Schematic of the VKO [cable entrance equipment] of the V-60-E equipment.

Key: 1. To the cable box;
2. VKO;
3. To the HF amplifier;
4. To the remote power supply equipment;
5. ZF-50 [?50 Hz suppression filter?];
6. To service communications and remote control;
7. To the cable box;
8. To the HF ampliifer(s);

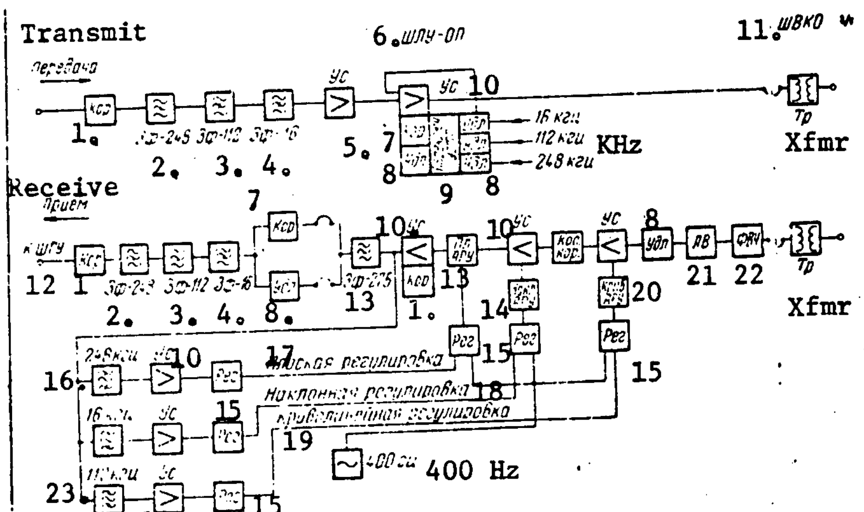


Рис. IV.9.7. Блок-схема линейных усилителей ШЛУ-ОП аппаратуры V-60-E

Figure 4.9.7. Block diagram of the line amplifiers of the ShLU-OP [terminal station line amplifier cabinet] of the V-60-E equipment.

Key: 1. Corrective network;
2. ZF-248 [248 KHz suppression filter];
3. ZF-112;

[Key to Figure 4.9.7, continued]:

4. ZF-16 [16 KHz suppression filter];
5. Amplifier;
6. ShLU-OP [Terminal station line amplifier cabinet];
7. Corrective network;
8. Pad;
9. Switcher;
10. Amplifier;
11. ShVKO [cabinet of cable entrance equipment];
12. To the ShGU [cabinet of group converters];
13. Flat type AGC;
14. Slope type AGC;
15. Control;
16. 248 KHz;
17. Flat type control;
18. Slope type control;
19. Curvilinear type control;
20. Curvilinear AGC;
21. Line equalizer;
22. FVCh [high pass filter];
23. 112 KHz.

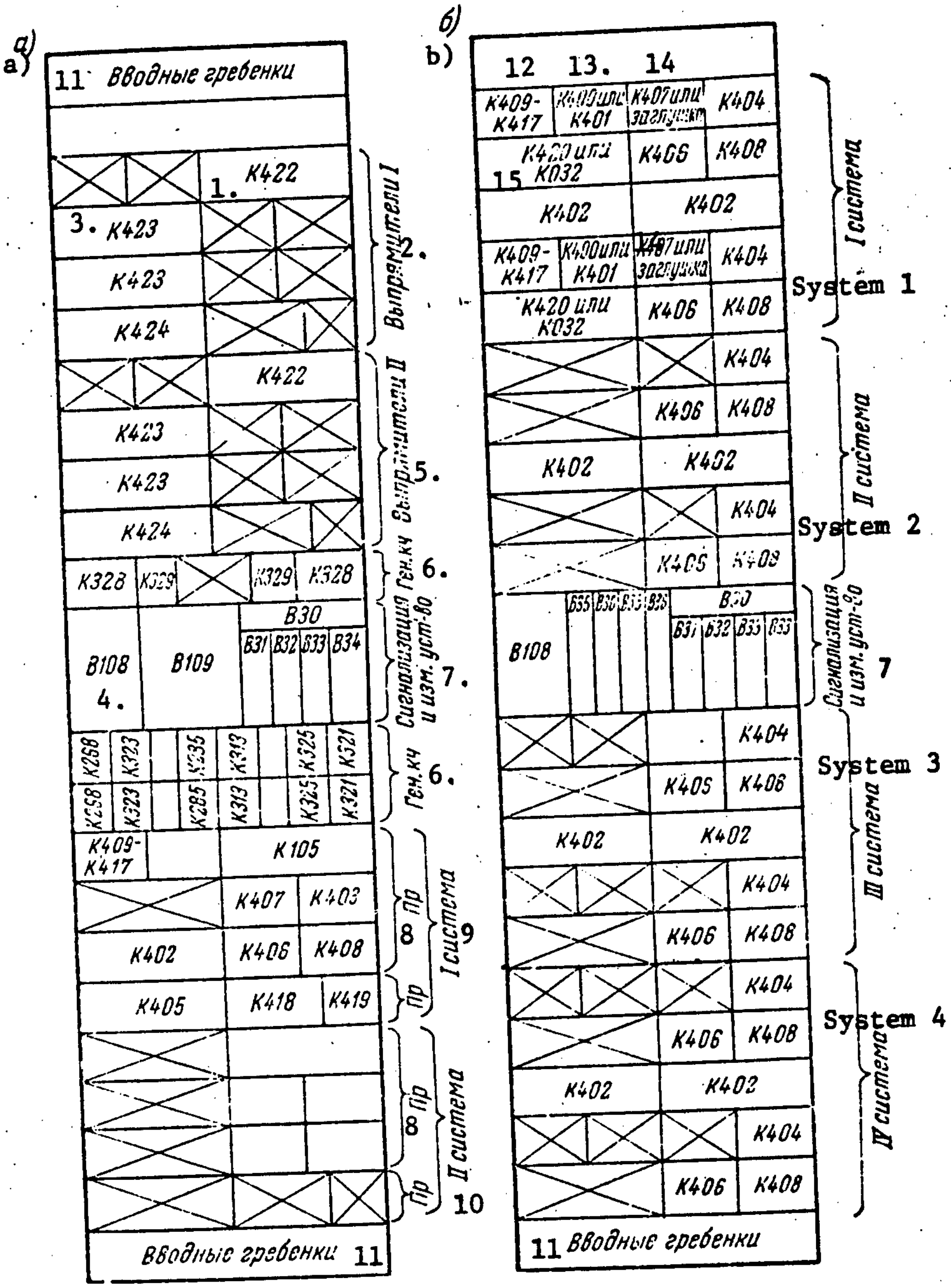


Figure 4.9.8. The placement of the equipment in the cabinet of line amplifiers of the V-60-E equipment.
a) For a ShLU-OP terminal station;
b) For a ShLU-OUP attended repeater station.

Key: 1. K422 [channel 422 (module)];
2. Rectifiers I;
3. K423;

[Key to Figure 4.9.8, continued]:

4. V108 [expansion unknown];
5. Rectifiers II;
6. Control frequency generators;
7. Signaling and measurement unit;
8. Pr [abbreviation for either receive/receiver or conversion/converter];
9. System 1;
10. System 2;
11. Input terminal blocks;
12. K409 - K417;
13. K400 or K401;
14. K407 or blank panel;
15. K420 or K032.

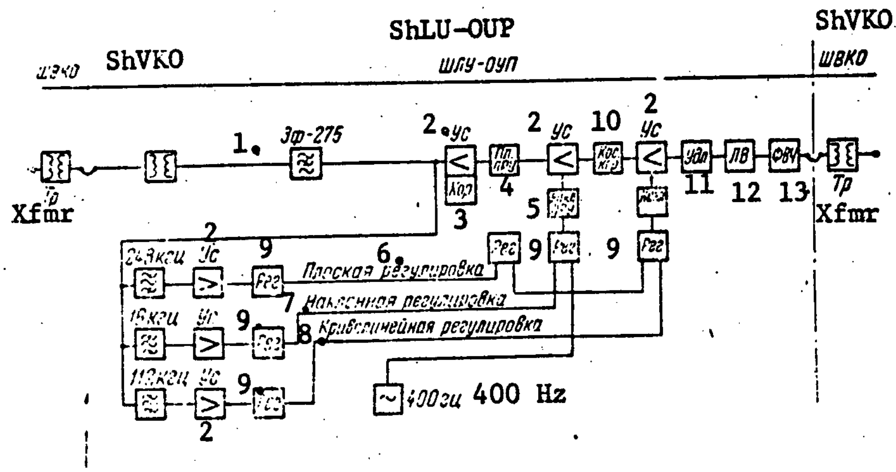


Figure 4.9.9. Block diagram of the cabinet of line amplifiers, ShLU-OUP of the V-60-E equipment.

Key: 1. ZF-275 [275 KHz suppression filter];
2. Amplifier;
3. Corrective network;
4. Flat type AGC;
5. Slope type AGC;
6. Flat control;
7. Slope control;
8. Curvilinear control;
9. Control unit;
10. Cosine corrective network;
11. Pad;
12. Line equalizer;
13. HF filter.

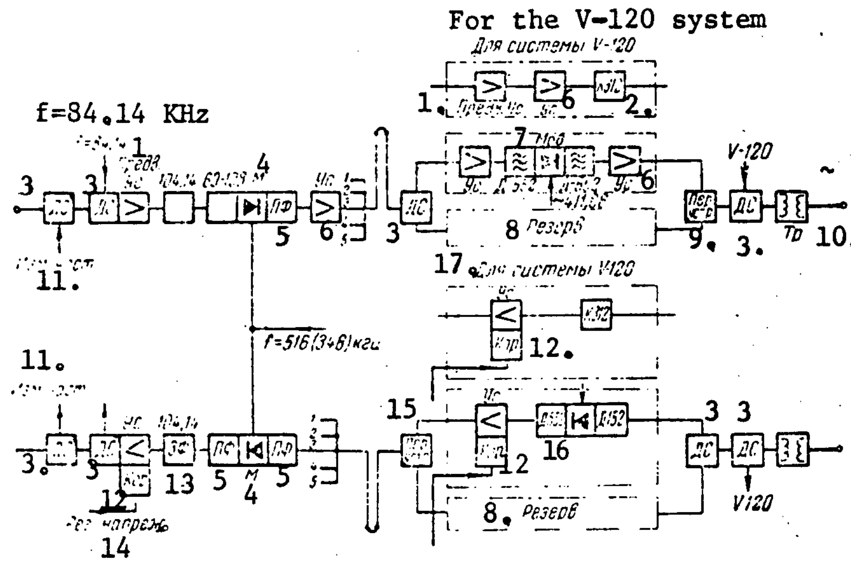
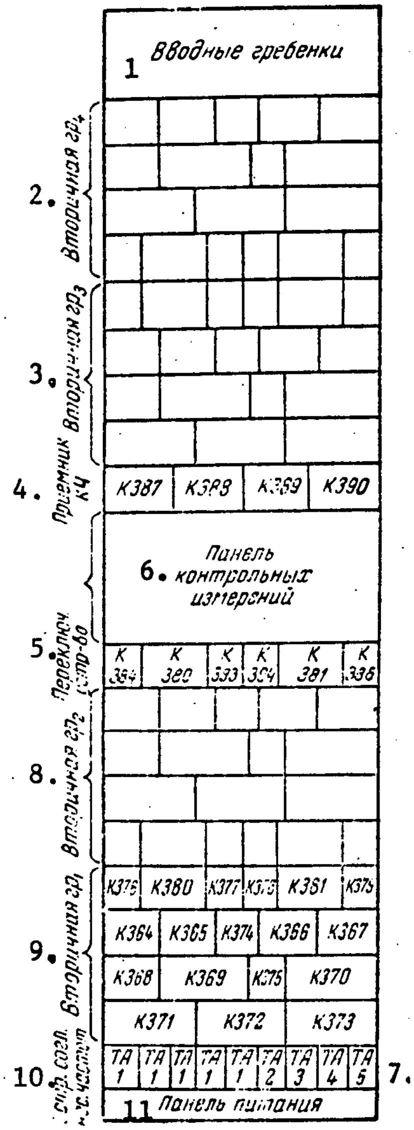


Figure 4.9.10. Block diagram of the cabinet of group devices, ShGU, of the V-60-E equipment.

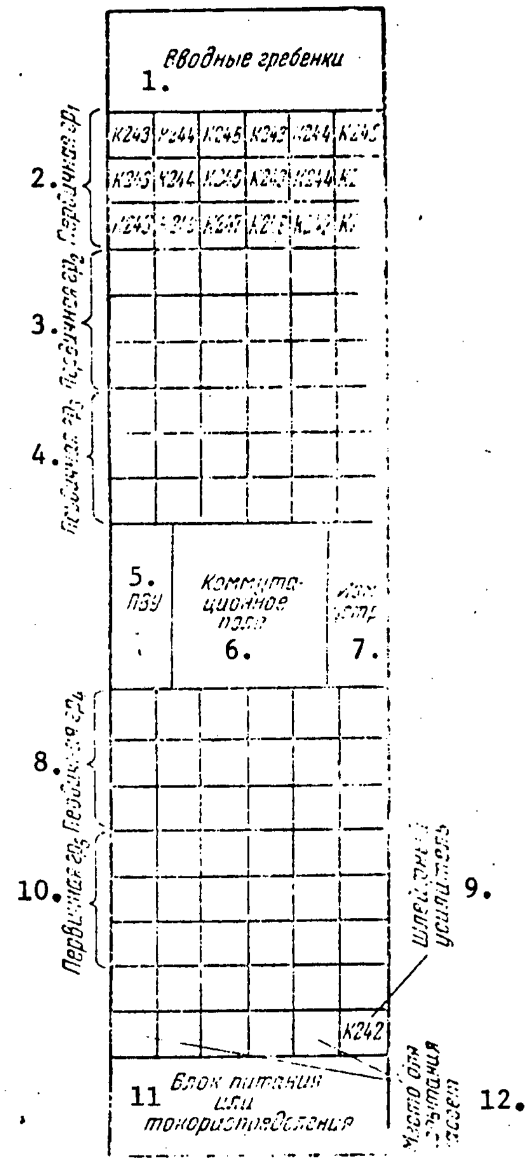
Key: 1. Preamplifier;
2. K312 filter;
3. Differential system;
4. M [modulator];
5. PF [bandpass filter];
6. Amplifier;
7. Modulator;
8. Standby;
9. Switcher;
10. Transformer;
11. Measurement frequency;
12. Corrective network;
13. ZF [suppression filter];
14. Control voltage;
15. Switcher;
16. D-552 filter.
17. For the V-120 system.



Key:

1. Input terminal blocks;
2. Secondary group 4;
3. Secondary group 3;
4. Control channel receiver;
5. Switcher;
6. Panel for monitor measurements;
7. TA5 [expansion unknown];
8. Secondary group 2;
9. Secondary group 1;
10. Carrier frequency matching unit;
11. Power supply panel.

Figure 4.9.11. The placement of the equipment in the cabinet of group devices, ShGU, of the V-60-E equipment.



Key:

1. Input terminal blocks;
2. Primary group 1;
3. Primary group 2;
4. Primary group 3;
5. PVU [intercom-callup unit];
6. Jackfield;
7. Measurement unit;
8. Primary group 4;
9. Loop amplifier;
10. Primary group 5;
11. Power supply or current distribution block;
12. Location for module testing.

Figure 4.9.12. The placement of the equipment in the cabinet of channel converters, ShKP, of the V-60-E equipment.

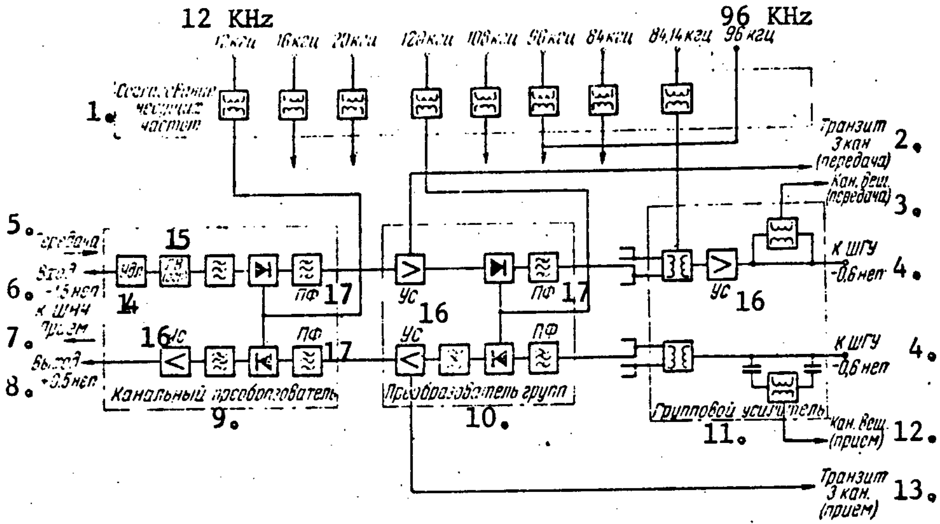


Figure 4.9.13. Block diagram of the channel converter cabinet, ShKP, of the V-60-E equipment.

Key: 1. Carrier frequency matching;
2. Three channel through working (transmit);
3. Broadcast channel (transmit);
4. To the ShGU, -0.6 nepers;
5. Transmit;
6. Input, -1.5 nepers;
7. To the ShNCh, receive;
8. Output, +0.5 nepers;
9. Channel converter;
10. Group converter;
11. Group amplifier;
12. Broadcast channel (receive);
13. Three-channel through-working (receive);
14. Pad;
15. LV (ogr) [line equalizer (?or limiter?)];
16. Amplifier;
17. PF [bandpass filter].

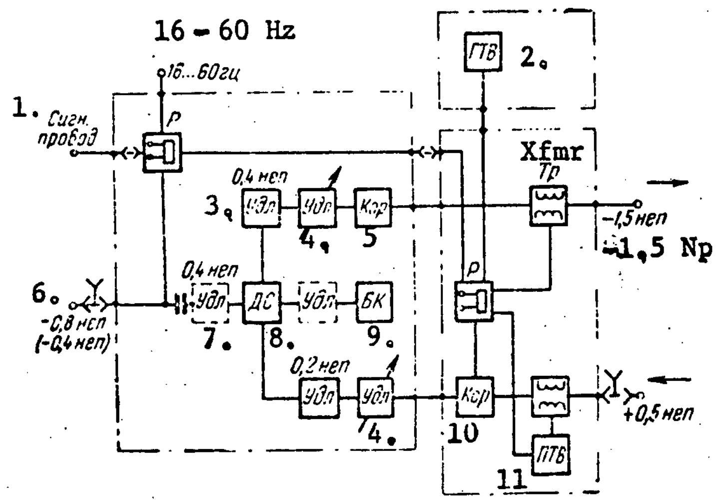


Figure 4.9.14. Block diagram of the low frequency cabinet, ShNCh, of the V-60-E equipment.

Key: 1. Signal wire;
2. GTV [voice frequency ringing generator];
3. Pad, 0.4 Np;
4. Variable pad;
5. Corrective network;
6. -0.8 Np (or -0.4 Np);
7. Pad; 0.4 Np;
8. Differential system;
9. Balancing network;
10. Corrective network;
11. PTV [voice frequency ringing receiver].

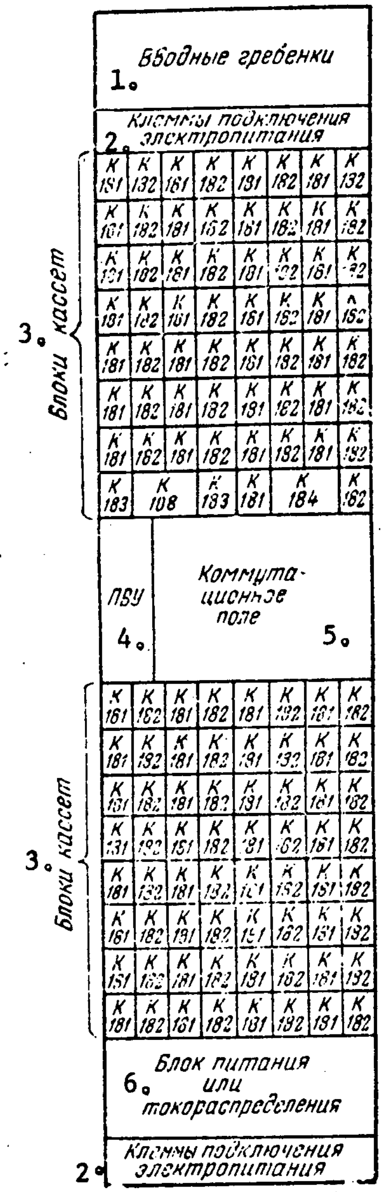


Figure 4.9.15. The placement of the equipment in the low frequency cabinet, ShNCh, of the V-60-E equipment.
Key: 1. Input terminal blocks;
2. Electrical power supply connection terminals;
3. Blocks of modules
4. Intercom-callup unit;
5. Jack field;
6. Power or current distribution block.

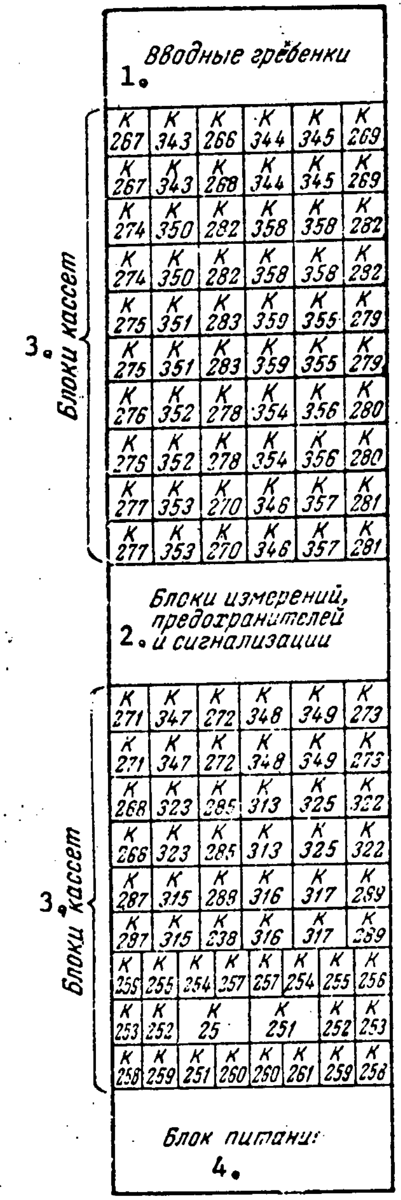


Figure 4.9.16. The placement of the equipment in the cabinet of carrier and control frequency generators, ShGNK, of the V-60-E equipment.
Key: 1. Input terminal blocks;
2. Blocks for measurements, fuses and signaling;
3. Blocks of modules;
4. Power supply block.

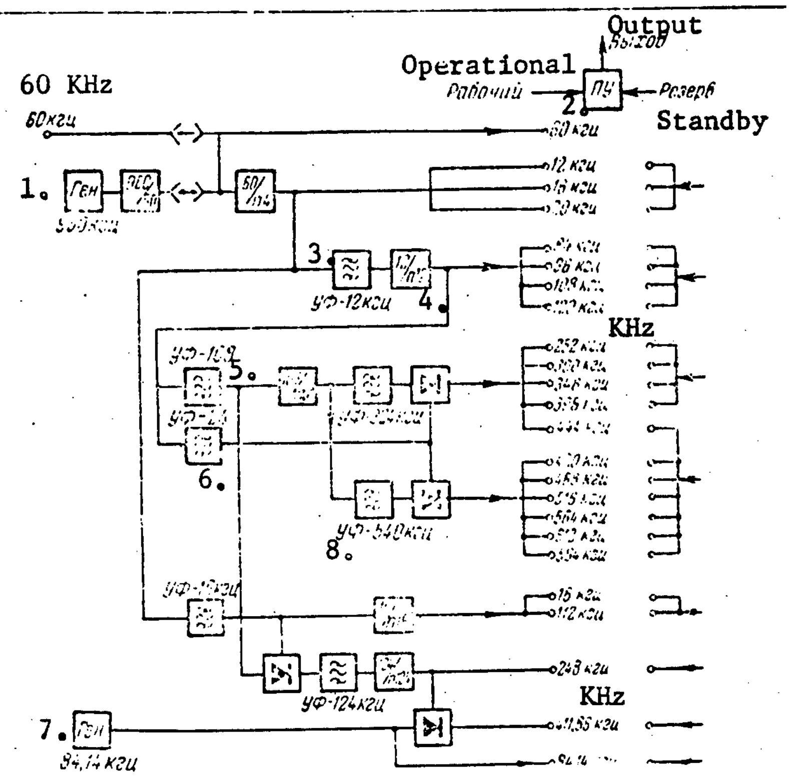


Figure 4.9.17. Block diagram of the cabinet of the carrier and control frequency generators, ShGNK, of the V-60-E equipment.

Key:
1. 960 KHz oscillator;
2. Switcher;
3. 12 KHz narrow band filter;
4. Unknown type of frequency multiplier;
5. 108 KHz narrow band filter;
6. 24 KHz narrow band filter;
7. 84.14 KHz oscillator;
8. 540 KHz narrow band filter.

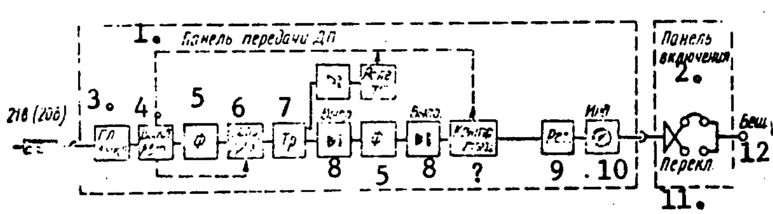


Figure 4.9.18. Block diagram of the remote power supply cabinet, ShDP, of the V-60-E equipment.

Key:
1. Remote power transmit panel;
2. Connection panel;
3. Master switch;
4. Automatic switch;
5. F [?filter?];
6. Vibrator inverter;

[Key to Figure 4.9.18, continued]:

7. Transformer;
8. Rectifier;
9. Control;
10. Meter;
11. Changeover switch;
12. Vesch. [?broadcast?].

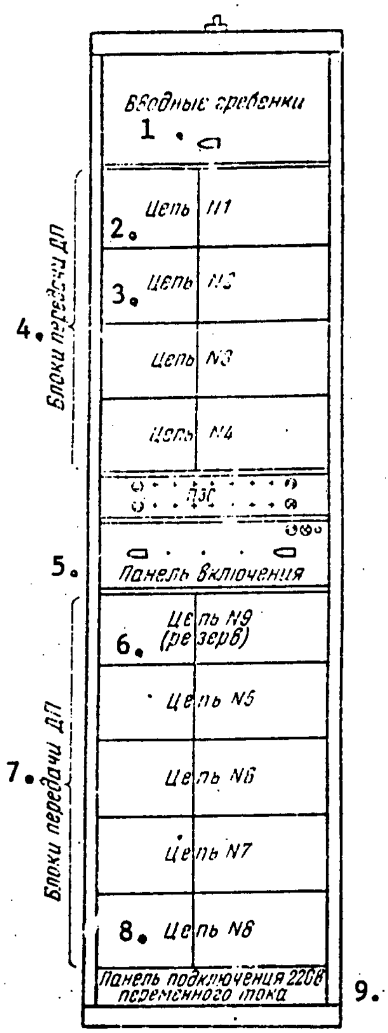


Figure 4.9.19. The placement of the equipment in the remote power supply cabinet, ShDP, of the V-60-E equipment.

Key: 1. Input terminal blocks;
2. Circuit No. 1;
3. Circuit No. 2;
4. Remote power transmission blocks;
5. Connection panel;
6. Circuit No. 9 (standby);
7. Remote power transmission blocks;
8. Circuit No. 8;
9. Panel for the connection of the 220 volts AC.

пзс = Fuse and signaling panel.

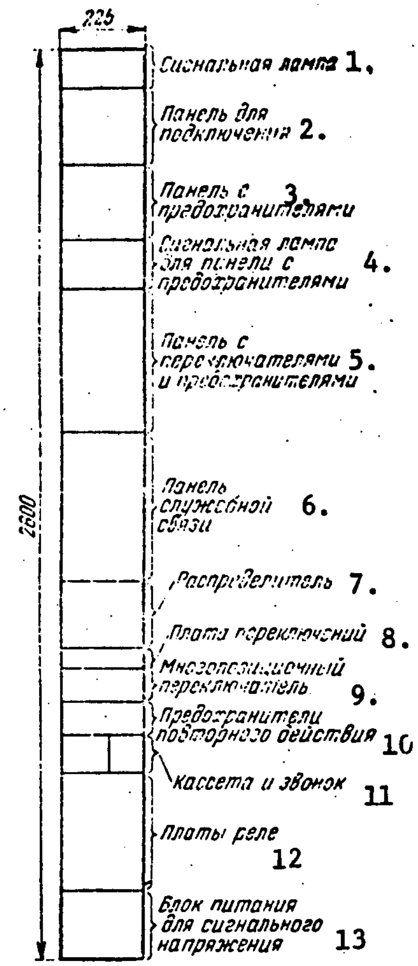


Figure 4.9.20. The head-end cabinet for electrical power distribution, GSh-1, of the V-60-E equipment.

Key:
1. Signal light;
2. Connection panel;
3. Panel with fuses;
4. Signal light for the fuse panel;
5. Panel with changeover switches and fuses;
6. Service communications panel;
7. Distributor;
8. Changeover switching panel;
9. Multiposition switch;
10. Circuit breakers;
11. Module and alarm;
12. Relay panels;
13. Power supply block for the signal voltage.

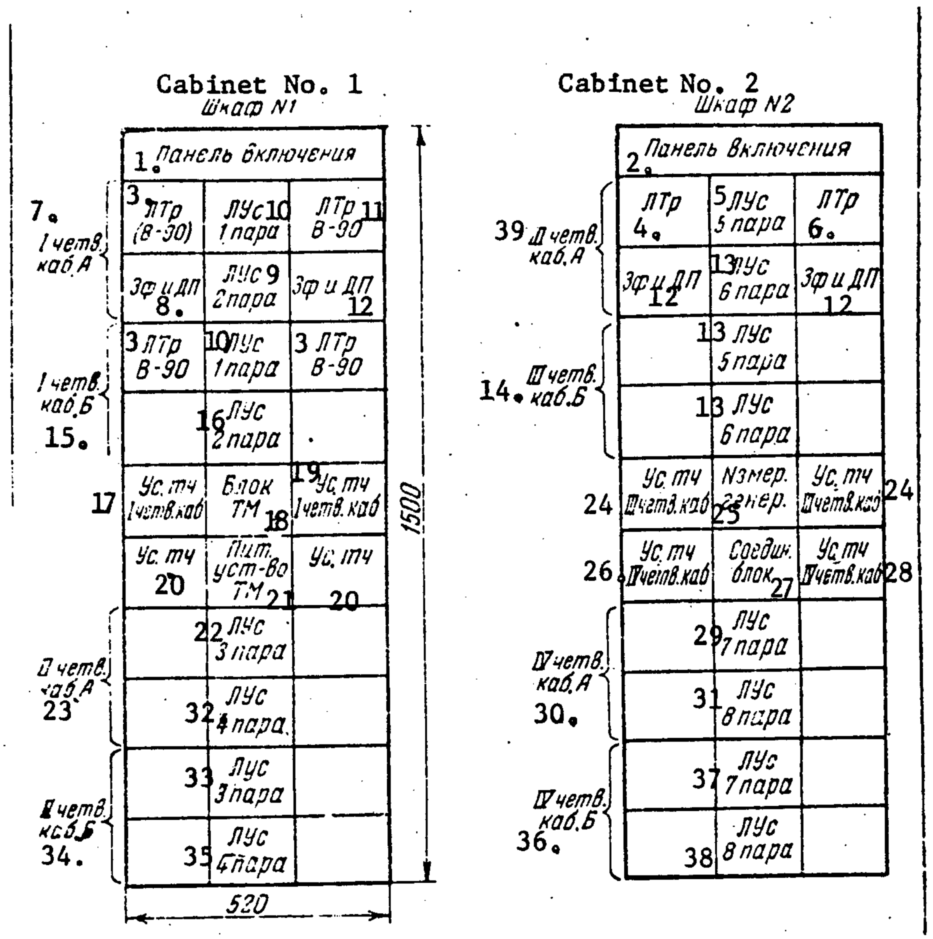


Figure 4.9.21. The placement of the equipment in the cabinet of line amplifiers for an unattended repeater station, ShLU NUP, of the V-60-E equipment.

Key:
1. Connection panel;
2. Connection panel;
3. Line transformer (V-90);
4. Line transformer;
5. Line amplifier, pair 5;
6. Line transformer;
7. Quad 1 of cable A;
8. Suppression filter and remote power;
9. Line amplifier, pair 2;
10. Line amplifier, pair 1;
11. Line transformer, V-90;
12. Suppression filter and remote power;
13. Line amplifier, pair 6;
14. Quad 3 of cable B;
15. Quad 1 of cable B;
16. Line amplifier, pair 2;
17. Voice frequency amplifier, cable quad 1;
18. Remote control block;
19. Voice frequency amplifier; cable quad 1;
20. Voice frequency amplifier;
21. Remote control panel power supply unit;
22. Line amplifier, pair 3;
23. Quad 2 of cable A;
24. Voice frequency amplifier, cable quad 3;
25. Measurement generator;
26. Voice frequency amplifier, cable quad 4;
27. Interconnection block;

[Key to Figure 4.9.21, continued]:

28. Voice frequency amplifier, cable quad 4;
29. Line amplifier, pair 7;
30. Quad 4 of cable A;
31. Line amplifier, pair 8;
32. Line amplifier, pair 4;
33. Line amplifier, pair 3;
34. Quad 2 of cable B;
35. Line amplifier, pair 4;
36. Quad 4 of cable B;
37. Line amplifier, pair 7;
38. Line amplifier, pair 8.
39. Quad 3 of cable A.

[Key to Figure 4.9.22 (page 392)]:

1. LIne transformer;
2. ShVKO [cable entrance equipment cabinet];
3. Trunk equalizer;
4. K-12 filter;
5. Line equalizer;
6. Control;
7. Line amplifier;
8. Pad;
9. Transformer;
10. Equalizer;
11. ShLU NUP [line amplifier cabinet of an unattended repeater];
12. Telephone set;
13. Line transformer;
14. To the temperature sensor;
15. Measurement generator;
16. D-8 filter;
17. Phantom transformer;
18. Equalizer;
19. K-0.3 filter;
20. Us. TS [TS (expansion unknown) amplifier];
21. Transformer;
22. TM [?remote control?] transmit;
23. TP [expansion unknown] receive;
24. ZF-50 [50 Hz suppression filter];
25. Power supply.

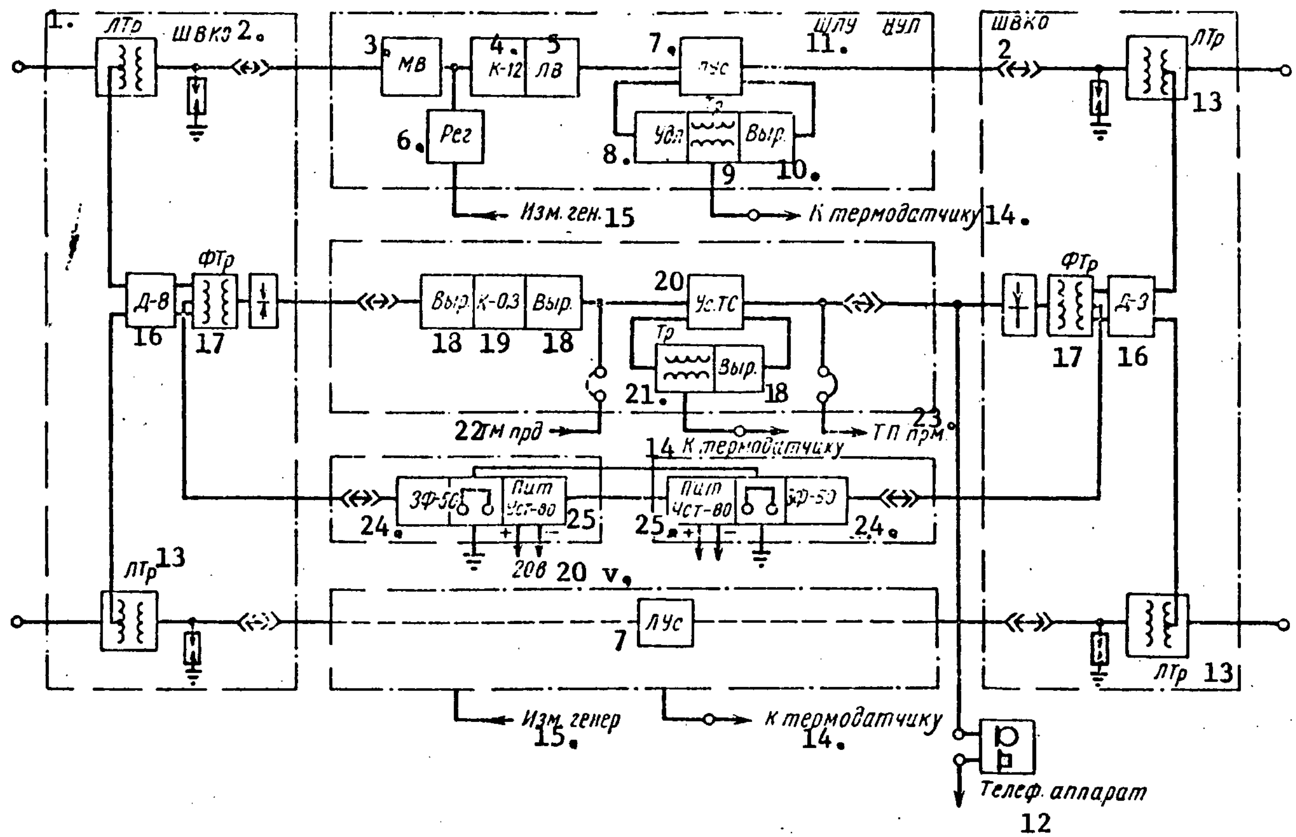


Figure 4.9.22. Skeleton schematic of the line amplifier cabinet of an unattended repeater station (ShLU NUP) of the V-60-E equipment.

4.10. The KRR-M and KRR 30-Channel Transmission Systems

Figures 4.10.1 - 4.10.9

Purpose

The equipment is intended for the HF multiplexing of balanced cables on short range lines (junction lines between ATS's [automatic telephone exchanges] and MTS's [long distance telephone exchanges], junction lines on municipal and suburban telephone networks), and for the HF multiplexing of radio relay trunks over short distances.

In the modernized equipment, the KRR-M, which has been series produced by industry since 1966, the transceivers of the terminal stations have been improved, the remote power supply circuit board has been brought out of the SIG-1 racks [individual and group equipment racks], and changes have been introduced in the electrical circuitry of the terminal stations. The intermediate amplifier stations have not been modernized. Joint operation of the KRR-M equipment and the old series equipment (KRR) on the same circuit is not recommended.

Note: "Kama" type equipment, based on the KRR, will be produced in the near future.

Type of Line

A balanced, multipair spiral quad cable with copper cores 1.2 mm in diameter having cord-styroflex insulation (MKSB), as well as other brands of cable which have similar characteristics (which permit the utilization of KRR system equalizers). Also, radio relay links of the R-60/120 type.

The Communications System

Via cable pairs: single cable, two-band. Via radio relay links: a radio relay link trunk (equivalent to two pairs, located in different cables).

Note: The use of equipment in a single-band, two cable system is permitted.

The communications system is formed from the KRR-M (or KRR) equipment and the relay and switching equipment, designed around individual RSLU-M [long distance, multiplex matching line connector relay complex] bays, in which the differential systems are also housed.

The RSLU-M bays are not included in the KRR-M (or KRR) equipment complement, and are ordered separately.

Electrical Characteristics

The line frequency spectrum:

Via a cable pair for the case of a single cable two-band system	12 - 248 KHz (A - B) 312 - 548 KHz (B - A)
Via radio relay links or cable pairs for the case of a two-cable, single band system	12 - 248 KHz and 312 - 548 KHz in both transmit directions

The number of channels which can be organized:

Via a cable pair for the case of a single cable, two-band system	30 channels via one pair. By means of supplemental equipment racks (SIG-30), it is possible to organize 60, 90 and 120 channels via 2, 3 and 4 pairs respectively.
Via radio relay links or cable pairs for the case of a two-cable, single band system	60 channels

In this case, two complexes are combined at the terminal stations: the SIG-1A and SIG-30B, or the SIG-1B and the SIG-30A (a radio relay link trunk is equivalent to two cable pairs, located in different cables).

Maximum communications range via MKS cable	80 km
Number of repeater sections	6
The length of a repeater section via MKS cable:	
Average	13 km
Minimum	5.5 km
The residual channel attenuation	0.4 Np or 0.8 Np
The effective transmitted bandwidth	300 - 3,400 Hz

The nominal relative level in the four-wire section of the channel:	
At the input	- 1.5 Np
At the output	+ 0.5 Np
The nominal relative transmission level at the output of the group amplifier when working through a cable	- 0.25 Np (at the upper transmitted frequency of the band).
Input impedance of the equipment (terminal and intermediate) from the:	
Line end	160 ohms for the case of a balanced circuit. The reflection factor is no more than 0.20 (for the KRR-0.18).
Exchange end	600 ohms. The reflection factor is no more than 0.2 (for the KRR-0.3).
The input and output impedance of the group channel units of the terminal and intermediate equipment	75 ohms for the case of an unbalanced circuit.
The psophometric noise voltage of a channel at a point with a measurement level of + 0.5 Np	$\leq$ 1 mv for 70% of the channels; $\leq$ 1.3 mv for 30% of the channels
Gain control of the group channels	In steps of 0.5 Np each. Continuously in the feedback circuit by 0.35 Np.
The control range of the low frequency amplifier (the demodulator amplifier)	No less than $\pm$ 0.5 Np.
The amplification of the group channels at the center frequency:	
Maximum	from 6.15 to 6.3 Np
Minimum	from 5.3 to 5.45 Np

(for the KRR equipment, the amplification amounts to the following: from 2.0 Np to 6.9 Np at a frequency of 552 KHz, and from 1.5 to 4.7 Np at a frequency of 252 KHz).

The call-up system via the HF cahnnels	Voice frequency ringing at 3,800 Hz with a level 0.4 - 0.8 Np lower than the speech channel level.
The system for service communications between exchanges:	
Between terminal exchanges	via the HF channel;
Between all exchanges	via phantom circuit voice frequency channels.

The line equalizers for correcting the amplitude-frequency distortion have an attenuation at the maximum frequency of no more than 0.05 Np.

The synchronization channel for the equipment operates at 8 KHz (a terminal station can operate from the sync frequency transmitted by station A).

Climatic Operational Conditions

The equipment operates at a temperature of from + 10 to + 35° C, and a relative humidity of up to 85%, as well as when the temperature is + 40° C and the relative humidity is 65%.

Electrical Power Supply

Voltages:

The SIG-1, SIG-30, SIG-1M and SIG-30M terminal stations	The AC mains at 220/380 volts with fluctuations of +8% and -17%. The voltage is regulated by the S-0.9 regulator (for the KRR equipment, using the AC mains at 127/220 volts). DC voltage at 60 volts with fluctuations of +4 volts and -2 volts to power the static relays and the PSU circuits. Also, 60 volts or 24 volts DC for the signaling circuits.
The SPU-2M intermediate station amplifiers using lower power	The AC mains at 220/380 volts, or direct current at 160 volts.
The SPU-2D intermediate amplifier stations with remote power	Remote DC power at 160 volts when 240 - 270 volts is fed into the line. The DP [remote power] receiving board feeds both SPU-2D amplifiers, connected in series.
The RSLU-M bays	60 volts DC

Current and Power Consumption

Оборудование Equipment	127/220 в, вт 127/220 v watts	210,380 в, вт 210/380 v watts	=160 в, а = 160 v, a	=60 в, а = 60 v, a	
1. Аппаратура КРР-М					
СИГ-1М	—	570	—	0,35	SIG-1M
СИГ-30М	—	70	—	0,2	SIG-30M
2. Аппаратура КРР					
СИГ-1	600	—	—	0,35	SIG-1
СИГ-30	60	—	—	0,2	SIG-30
3. Аппаратура КРР-М и КРР					
СПУ-2М	—	110	0,35	—	SPU-2M
СПУ-2Д	—	—	0,35 ДП (4)	--	SPU-2D

Key: 1. KRR-M equipment; 2. KRR equipment; 3. KRR-M and KRR equipment
4. 0.35 amps, remote power.

The Equipment Complement

The Terminal Station

SIG-1M (SIG-1). The individual and group equipment rack for transmission in a frequency spectrum of 12 - 248 KHz (SIG-1A) or in a spectrum of 312 - 548 KHz (SIG-1B). Housed in the rack are: the individual equipment (transceivers) for 30 channels; the group equipment for 30 channels with the line transformer and protection unit; the oscillator equipment for 120 channels; a board of 30 static relays (the remaining three boards are also installed in the SIG-1M, but are supplied with the SIG-30 racks).

Notes: 1. Added to the SIG-1 rack is an S-0.9 AC regulator, which is mounted outside the rack in a special chassis;
2. The SIG-1 rack provides four 30-cahnnel systems with carrier frequencies, i.e. 120 channels;
3. The remaining generator blocks have a 100% back-up;
4. The remote power transmit board is installed in the VKS rack or a special support.

The SIG-30M (or SIG-30). The individual and group equipment racks for increasing the capacity of the SIG-1M (or SIG-1) rack. Housed in the rack are the following: the individual equipment for 30 channels; the group equipment for 30 channels.

The SIG-30M (SIG-30) rack operates only in conjunction with the SIG-1M (or SIG-1) rack, since located in the latter is the common oscillator equipment. Depending on the transmission route (A or B), the racks are subdivided into: the SIG-30MA (or SIG-30A), and the SIG-30MB (or SIG-30B).

Note: The board of static relays for 30 channels supplied with the rack is installed in the SIG-1 rack.

The RSLU-M. Bays with differential systems, pads and relays, for matching the circuits of automatic and long distance telephone exchange instruments to the KRR-M (or KRR) equipment circuits. Housed in the bays are 20 of any junction line complexes (outgoing or incoming).

Intermediate Amplifier Stations

The SPU-2M. An intermediate amplifier station with a local power supply. The stations is designed for two systems (two two-way repeaters). The stations can be mounted one on the other (up to four units).

The SPD-2D [sic]. An intermediate amplifier station, remotely powered from terminal stations. It differs from the SPU-2M station in that in place of the local power supply board, installed in the SPU-2D is a remote power reception board.

Note: The plant supplies the following on special order:

a) Frames for mounting the SPU in an NUP [unattended repeater amplifier station] in accordance with drawing RT4 137.005;

b) A support for the SIG-30M (to increase the overall height up to 2,600 mm), where two SIG-30M's are present, in accordance with drawing RT4 136.004;

c) A support for the SPU (to increase the overall height up 2,600 mm) when installing four SPU's, as well as for the remote power transmission board, when the latter is installed separately at repeater amplifier points, in accordance with drawing RT 136.001;

d) A support having the dimensions of the SPU, to increase the height up to 2,600 mm (installed in place of the SPU complex) in accordance with drawing RT4 136.002;

e) A frame for mounting the SPU-2M in an OUP [attended repeater amplifier station] in accordance with drawing RT4 137.006

Structural Design

The SIG-1. Mounted on a chassis of formed sheet steel. The blocks are installed on shelves (pans), in which the equipment assemblies are placed. The rack mounting is positioned in the interior part of the frame. The rack dimensions are 2,600 x 644 x 250 mm (with the protruding parts of the rack being 280 mm deep).

The SIG-30. Installed on the same principle as the SIG-1, on one chassis. Three SIG-30 complexes can be stacked on top of each other up to the overall height of 2,600 mm. For a smaller number of SIG-30 complexes, cabinet supports, similar to the SIG-30 complexes in size, can be employed. Dimensions: 863 x 644 x 250 mm.

The SPU-2D and SPU-2M. Installed on the same principle as the SIG-1 racks. The structural design of the racks provides for the capability of stacking them together up to an overall height of 2,600 mm with up to four units (with a 188 mm support). The dimensions of the SPU-2D or SPU-2M rack are 603 x 644 x 250 mm.

The RSLU and RSLUM. Dimensions: 2,365 x 381 x 200 mm

Cost and Weight:

Equipment	Weight, kg	Cost, rubles
SIG-1M	400	5,939
SIG-30M	115	4,098
SPU-2M	80	923
SPU-2D	80	915
DP [remote power] board	22	106
SIG-1	328	5,500
SIG-30	115	3,300
Frame RT4.137.005	50	5
Support RT4.136.004	32	39
Support RT4.136.001	9.5	31
Support RT4.136.002	25	50
Frame RT4.137.006	60	36

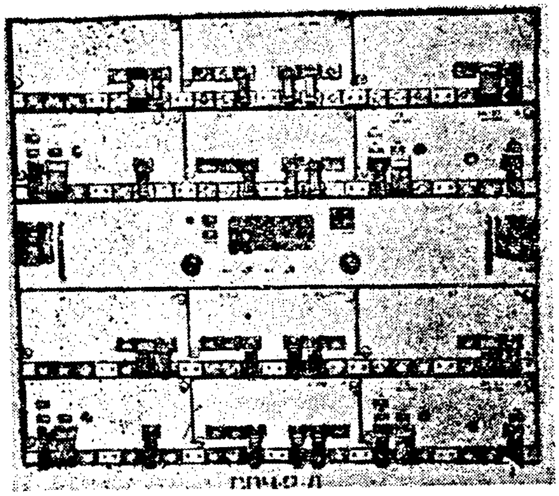


Figure 4.10.1.

External view of the SPU-2D intermediate amplifiers of the KRR equipment.

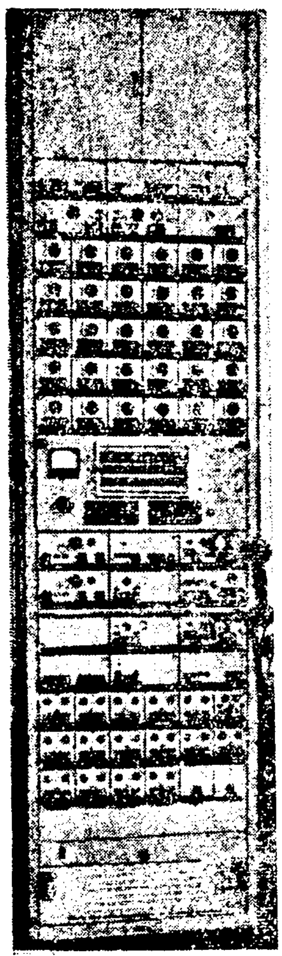


Figure 4.10.2. External view of the terminal station of the KRR-M equipment.

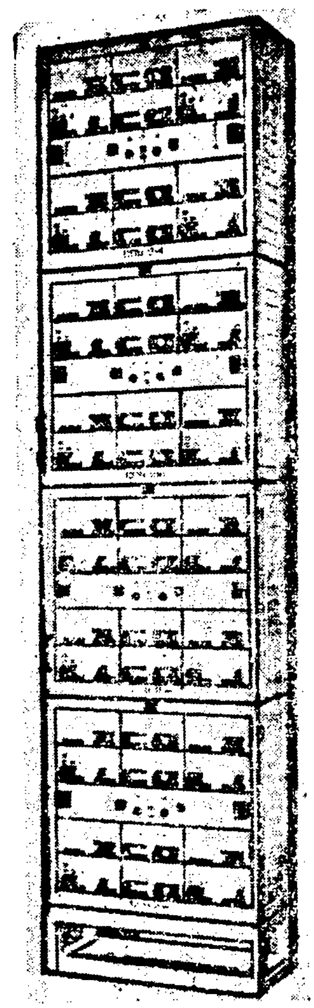


Figure 4.10.3. External view of the intermediate station of the KRR equipment.

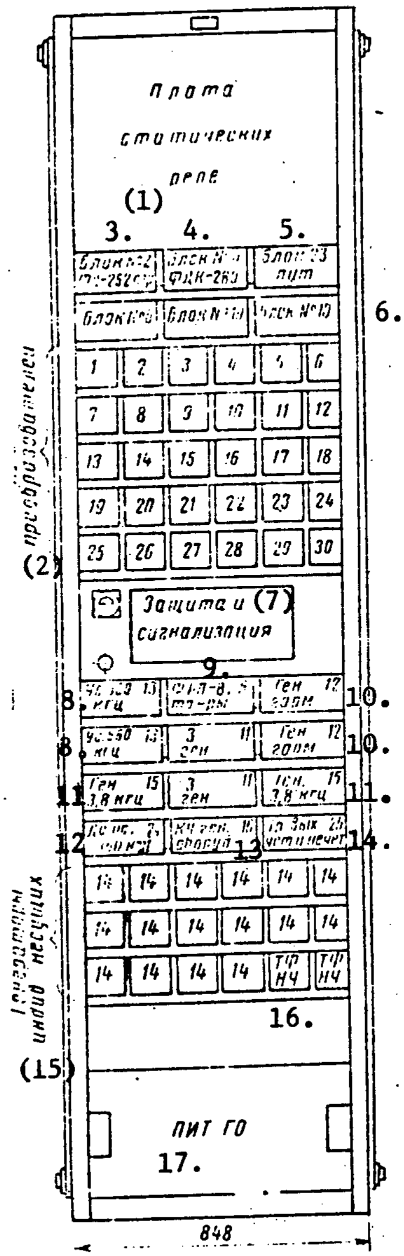


Figure 4.10.4.

The placement of the equipment in the individual and group equipment rack, the SIG-1MA, of the KRR equipment (in the SIG-1MB rack, blocks 2, 19 and 6 are replaced by blocks 8, 3 and 7 respectively).

Key:
1. Static relay board;
2. [word lost in poor copy] converters;
3. Block No. 2, FD-252 atr;
4. Block No. 4, FDK-280 [280 KHz rejection filter];
5. Block 23, power;
6. Block 10;
7. Protection and signaling;
8. 560 KHz amplifier;
9. [?FNP-8?] transformers;
10. Harmonic generator
11. 3.8 KHz oscillator;
12. 360 KHz Ds Us [?differential system - amplifier];
13. KCh generator equipment [monitor frequency oscillator for AGC system];
14. Output transformer, even and odd [harmonics];
15. Individual carrier frequency oscillators;
16. TF NCh [?Telephony Low frequency?];
17. Generator equipment power supply.

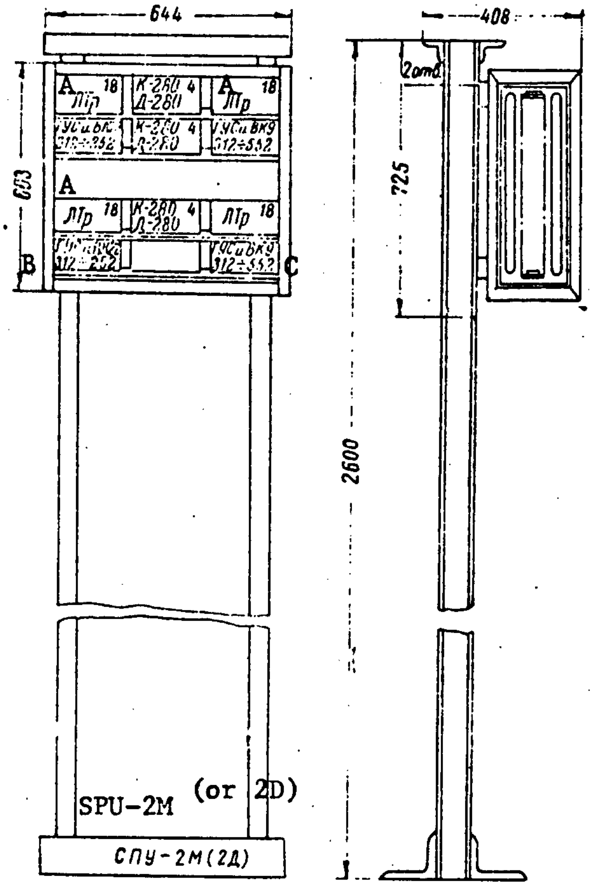


Figure 4.10.5.

The placement of equipment in the SPU-2M and SPU-2D intermediate amplifier rack of the KRR equipment.

Key:

A. LTr [line transformer];
B. 312 - 252 KHz equalizing network and group amplifier;
C. 312 - 552 KHz equalizing network and group amplifier.

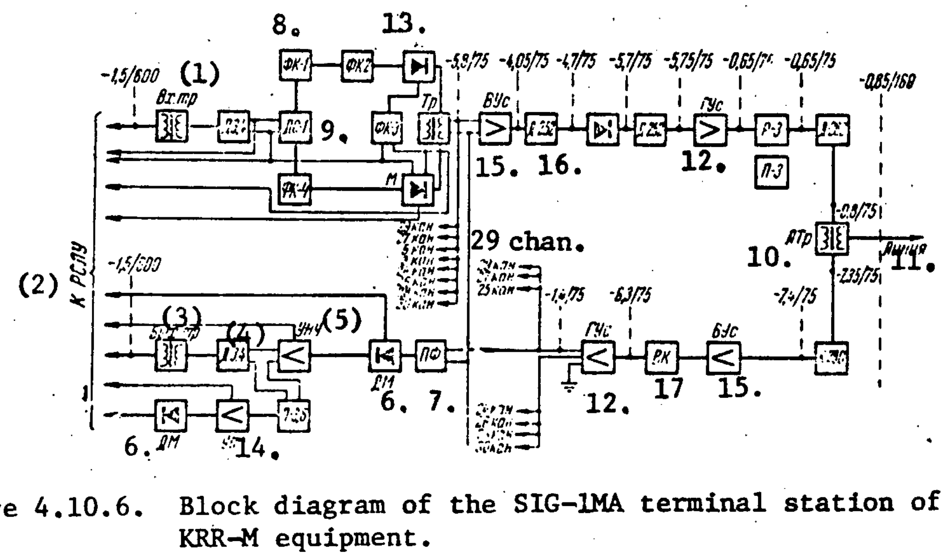


Figure 4.10.6. Block diagram of the SIG-1MA terminal station of the KRR-M equipment.

Key: 1. Input transformer;

[Key to Figure 4.10.6, continued]:

2. To the RSLU [multiplex matching line connector relay complex];
3. Output transformer;
4. D-3.4 [0 - 3.4 KHz low pass filter];
5. UNCh [low frequency amplifier];
6. Demodulator;
7. PF [bandpass filter];
8. FK-1 [channel filter 1];
9. DS-1 [differential system 1];
10. Line transformer;
11. Line;
12. Group amplifier;
13. M [?modulator?];
14. Us [amplifier];
15. VUs [?secondary amplifier?];
16. D-252 [252 KHz low pass filter];
17. VK [equalizing network];

K-280 [280 KHz high pass filter].

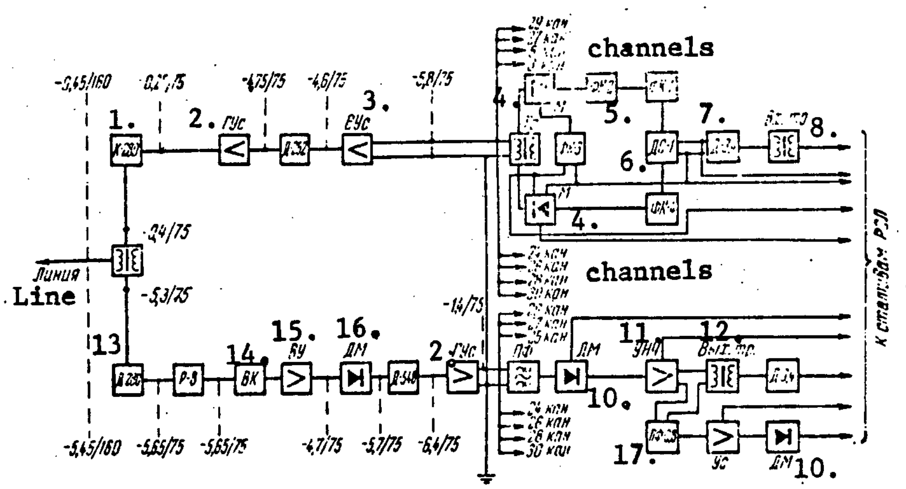


Figure 4.10.7. Block diagram of the SIG-1MB terminal station of the KRR-M equipment.

Key: 1. K-280 [280 KHz high pass filter];
2. GUs [group amplifier];
3. VUs [?secondary amplifier?];
4. Modulator;
5. FK-2 [channel filter 2];
6. DS-1 [differential system 1];
7. D-3.4 [0 - 3.4 KHz low pass filter];
8. Input transformer;
9. To the RSL [line connector relay] bays;
10. DM [?demodulator?];
11. Low frequency amplifier;

[Key to Figure 4.10.7]:

12. Output transformer;
13. D-280 [280 KHz low pass filter];
14. Equalizing network;
15. VU;
16. DM;
17. 3.8 KHz bandpass filter.

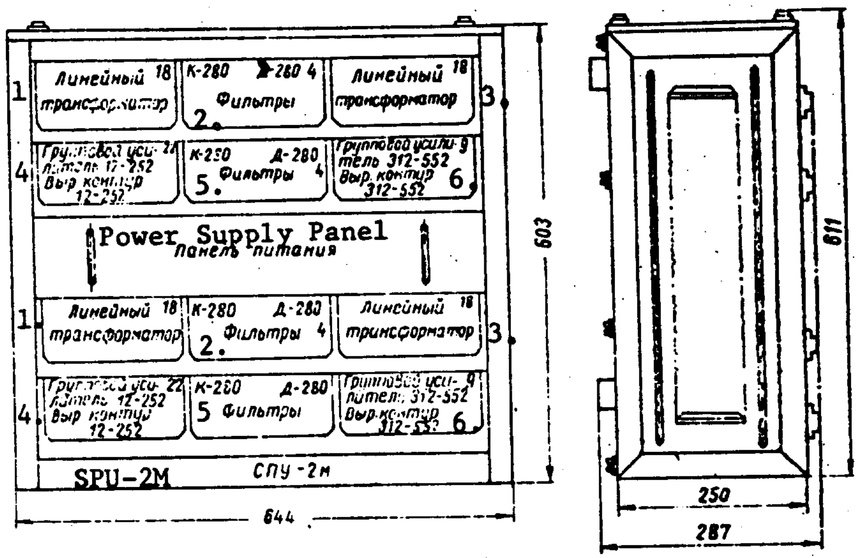


Figure 4.10.8. The placement of the equipment in the SPU-2M or SPU-2D intermediate amplifier rack of the KRR equipment;

Key: 1. Line transformer;
2. Filters; K-280 high pass filter and D-280 low pass filter;
3. Line transformer;
4. 12 - 252 KHz group amplifier and 12 - 252 KHz equalizing network;
5. K-280 and D-280 filters;
6. 312 - 552 KHz group amplifier and 312 - 552 KHz equalizing network;

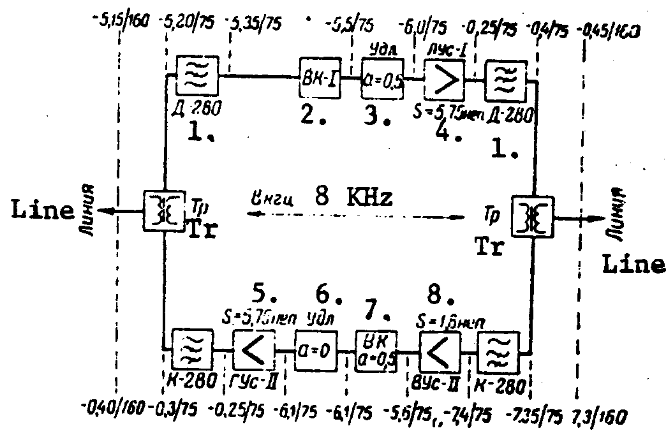


Figure 4.10.9. Block diagram of the SPU-2M or SPU-2D intermediate station of the KRR equipment.

Key: 1. D-280 low pass filter;
2. Equalizing network 1;
3. Pad, a = 0.5;
4. Line amplifier 1, S = 5.7 Np;
5. Group amplifier 2, S = 5.75 Np;
6. Pad, a = 0;
7. Equalizing network, a = 0.5;
8. [?secondary? amplifier 2, S = 1.8 Np;
K-280 = 280 KHz high pass filter.

[Continued in Part II]

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